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MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

Special chapter (revised) of *The State of Food and Agriculture 1992*

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Marine fisheries and the law of the sea: a decade of change
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ABSTRACT

Ten years after the signing of the United Nations Convention on the Law of the Sea, which marked the end of an era of freedom of the seas, this paper examines the changes that have occurred in marine fisheries and the adjustment made in the redistribution of benefits from the seas. While a few coastal states have gained large benefits and a few distant-water fishing nations have incurred large losses, there has been continued investment in large-scale vessels and a significant growth in fishing effort on the high seas beyond the 200-mile limits. The difficulty of improving the management of domestic fisheries and the required improvements in the competence of nations to exercise their newly gained authority are noted. While the 1980s might be considered a period of adjustment to the dramatic changes in the law of the sea, environmental issues have gained increasing significance during the decade and are posing difficult challenges particularly to the small-scale fishing communities in the coastal zones. Before the benefits from the ocean's fisheries can be fully realized, many tasks have to be completed, including concerted national and international efforts for better fisheries management.

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PREPARATION OF THIS DOCUMENT

Since 1957, *The State of Food and Agriculture* annual review has included one or more special studies of problems of longer-term interest. This present document is a revision of the special chapter from *The State of Food and Agriculture 1992*. Twelve years ago the 1980 special chapter, entitled "Marine fisheries in the new era of national jurisdiction", analysed the problems and opportunities for fisheries in the era following the United Nations Conference on the Law of the Sea (UNCLOS). This document reconsiders the state of world fisheries ten years after the signing of the 1982 UN Convention on the Law of the Sea. Whereas the 1980 edition was optimistic for improvements in the management of fishery resources as a result of extensions in national jurisdiction, this document shows that, within the decade, progress has been slow.

The issues and problems of both national and high sea fisheries would appear not to have changed significantly from those covered in the first special chapter on fisheries in *The State of Food and Agriculture 1967*, "The management of fishery resources". In that chapter, the difficulties experienced by international fishery commissions, the problems of excessive fishing effort, subsidies, enforcement and the need to reduce costs of fishing were discussed. Some 25 years later, it would now appear that, although understanding of the problems is almost universal, practical solutions are relatively few. The problems that then existed for the North Atlantic and the North Pacific have now expanded worldwide and primarily concern the difficulties of rational exploitation of common property resources.

Contents

MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

I. Introduction 1

II. The decade's developments 4

FISHERY RESOURCES 4

Marine catch and changes in production patterns 4

Catch by major fishing areas 7

Developments among regions and main fishing countries 10

Fish resources distribution during the 1980s 11

Coastal states 16

FISHING COSTS AND REVENUES 17

Fishing costs 17

Revenue 19

Prices 24

International trade 26

LEGAL, INSTITUTIONAL AND ENVIRONMENTAL DEVELOPMENTS 28

The law of the sea 28

International arrangements 28

Environment 29

III. Current and future issues 31

THE FUNDAMENTAL PROBLEM OF OPEN ACCESS 31

SUPPLY AND DEMAND 32

Resource effects 32

Supply increases 32

Supply shifts 36

Effects of demand 36

HIGH SEA FISHING 37

High sea pelagic fishing 37

Extended continental shelves and straddling stocks 39

High sea areas beyond narrow limits of jurisdiction 40

The international regime of the high seas 40

ENVIRONMENT 42

SMALL-SCALE FISHERIES 44

FISHERIES MANAGEMENT 46

IV. Appendix 1 50

FISHING COST METHODOLOGY 50

V. Appendix 2 54

FISHERIES STATISTICS 54

PART III
MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

I. Introduction
II. The decade's developments
III. Current and future issues
IV. Appendix 1
V. Appendix 2

MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

I. Introduction

Ten years ago, the United Nations Convention on the Law of the Sea was signed, marking the end of an era of freedom of the seas. For fisheries, however, the era of freedom had ended de facto during the 1970s when a majority of coastal states claimed jurisdiction over the resources within Exclusive Economic Zones (EEZs), i.e. waters within 200 nautical miles from their shores. The formal passing of the freedom of the seas provided the basis for the special chapter, Marine fisheries in the new era of national jurisdiction, in *The State of Food and Agriculture 1980*. As noted in that chapter: "The opportunity exists, as never before, for the rational exploitation of marine fisheries. Realization of the opportunity, however, will require major adjustments to the redistribution of benefits from the seas' wealth and improvements in the competence of the coastal states to exercise their newly acquired authority. The 1980s provide the threshold for a new era in the enjoyment of the oceans' wealth in fisheries."

Twelve years have passed since this was written and ten since the signing of the UN convention. It is an appropriate time to take stock of the changes that have occurred in marine fisheries and examine the adjustments that have been made and the challenges that have been met. This chapter attempts to do just that.

In general, the redistribution of the seas' wealth has proceeded as anticipated, with a few coastal states gaining large benefits and a few distant-water fishing states incurring large losses. Several developments were not foreseen, however. Most notable are the continued investment in large-scale fishing vessels capable of fishing great distances from port, and the significant growth in fishing effort on the high seas beyond the 200-mile limits.

With regard to improvements in the competence of nations to exercise their newly gained authority, developments in the 1980s have proceeded more slowly than anticipated. Coastal states with resources of interest to foreign countries have generally made considerable gains in managing their resources and extracting benefits from the foreign users. But improved management of domestic fisheries still has a long way to go. The task is difficult and many states are reluctant to take the necessary steps to assign and allocate exclusive use rights among their own fishermen.

In addition, environmental issues have become increasingly significant during the decade, posing difficult challenges. The major problems lie in the coastal zones where disparate uses from diverse sources are in conflict and where fisheries receive the brunt of the damage. The problems are particularly urgent for small-scale fishing communities in developing countries.

In general, the 1980s might be considered a period of adjustment to the dramatic changes that occurred in the law of the sea during the 1970s as well as a period of transition to the eventual achievement of substantial benefits from the oceans' fisheries. Many tasks have to be completed before those benefits can be fully realized, but the size of the rewards justifies a significant increase in the world community's concern for the problems of fisheries management.

BOX 10

From freedom of the seas to national jurisdiction

The era of freedom of the seas was initiated in the sixteenth and seventeenth centuries when the struggles to dominate the oceans and profitable trade routes were resolved by a mutual accommodation of interests. Fisheries provided one of the important arguments used to advance the principle of the freedom of the seas. Hugo Grotius, in his treatise *Mare Liberum* (1608), made two points: first, that fishery resources were so abundant that no benefits would accrue to exclusive jurisdiction; and second, that the resources were so extensive that national jurisdiction could not be effectively defended. Although the first point was somewhat specious, Grotius' arguments ultimately prevailed and the freedom of fishing became a major element in the freedom of the seas.

Under this principle, the fishermen of all countries had free and open access to the resources beyond the relatively narrow limits of coastal state jurisdiction; generally within three to twelve nautical miles from shore. The fishermen of Western Europe were the initial beneficiaries. When the herring stocks of the North Sea declined, fishermen moved to the Grand Banks off Newfoundland. As these stocks came under pressure, they moved south to the banks off New England, following the advice of Captain John Smith who, in 1610, reported that the Grand Banks are "so overlaide with fishers as the fishing decayeth and many are constrained to return with a small fraught".

And so the pattern was set. With declining catches per vessel in the traditional grounds, the fishermen either moved to new areas or adopted more intensive techniques. All that was required was the capital to invest in larger and more sophisticated vessels and gear. In more recent years, the pace of exploration and exploitation was expedited by the development of automotive power, synthetic fibre nets and refrigeration.

Until the Second World War, the distant-water fishing fleets came mostly from Western Europe and Japan. They were followed by the fleets of the former USSR, countries of Eastern Europe and a few developing countries, most notably Cuba, Ghana, the Republic of Korea and Taiwan, Province of China. United States fishermen extended their activities into the Antarctic for whales during the 1800s and, more recently, into the South Pacific for tuna.

During this era, the seas' wealth in fisheries was essentially appropriated by a few states, mostly the developed maritime countries which had the capital and the technology to take advantage of the opportunities offered by open access to the natural resources. Developing countries generally gained little and, in some cases, were harmed by foreign fleets decimating the fish stocks off their coasts. Even where there was no damage, the growing presence of large foreign fishing vessels off their coasts made them increasingly aware of the inequitable distribution of the wealth of the seas.

The end of the era was presaged in 1947 when Chile and Peru announced claims of extended jurisdiction up to 200 miles from their coasts. They were joined by Ecuador in 1952. The claims, partially a response to the appearance of United States tuna fleets off their coasts, remained largely a local matter between these states and the United States until 1958, when the issue of extent of jurisdiction was raised at the first UN Conference on the Law of the Sea. However, neither this conference nor the second one in 1960 resolved the issue, although a majority of states at that time

favoured narrow limits of control.

During the 1960s and 1970s, positions changed dramatically. It became much more evident that the supplies of fish stocks were limited and that depletion was becoming more prevalent. Attempts to manage resources through international bodies were proving to be largely ineffective. Many coastal states, developed and developing, felt increasingly threatened by the large fleets of the distant-water states off their coasts. Simultaneously, the issue of control over the mineral resources in the deep ocean beds raised the demands of developing states for a more equitable distribution of ocean wealth.

In 1967, the UN General Assembly established a Committee on the Peaceful Uses of the Sea-bed and the Ocean Floor beyond the Limits of National Jurisdiction. The mandate of the Committee expanded rapidly to cover all uses and resources of the sea, including fisheries. Interest in the work of the committee led to a rapid increase in membership and, eventually, to the convening of the third UN Conference on the Law of the Sea in 1973.

Concurrently, more and more states unilaterally extended their jurisdiction over fishery resources so that, by the mid-1970s, a majority of coastal states had asserted claims out to 200 nautical miles. The choice of 200 nautical miles as a limit for fisheries jurisdiction has no relevance to the habits of fish. Some species (e.g. oysters and clams) are sedentary while others (e.g. tuna and salmon) swim vast distances and are found both inside and outside 200-mile limits. There is also no direct connection between the size of fisheries zones and the wealth of their resources. The sea is not a vast bouillabaisse containing uniformly distributed treats, but an ocean of disparity with areas as barren as the Sahara and others as fertile as a rain forest. Among the latter are the continental shelves which are rich in demersal stocks (groundfish, such as cod and haddock) and the upwelling currents, inhabited by pelagic species (those feeding on the surface, such as sardines and anchoveta). Temperate zone waters tend to contain large populations of relatively few individual species while tropical waters have small populations of a large number of species. On the open ocean, the stocks are diffused. Some high sea species have schooling habits but require high search costs for their location. Others seldom aggregate and can only be caught using gear that filters great quantities of water.

The establishment of 200-mile Exclusive Economic Zones (EEZs) constitutes an accident of geography and has only limited relevance to the achievement of a more equitable distribution of wealth. Its most important function has been to provide coastal states with the authority to manage the resources within these zones.

MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

II. The decade's developments

FISHERY RESOURCES

Marine catch and changes in production patterns

World marine fisheries production has increased almost fivefold over the past 40 years, rising from around 18 million tonnes to more than 86 million tonnes by 1989. Catches for 1990 indicate a decline to 83 million tonnes but, at the trend rate of the past 20 years, the total catch would exceed 100 million tonnes by the year 2000.

Prior to 1970, the world catch of marine fish rose at the rapid rate of 6 percent per year but the collapse from 12 million to 2 million tonnes in Peruvian anchoveta fishing between 1970 and 1973 reduced the total catch of all marine species and marked a major break in the growth rate. Over the ensuing two decades, global marine catch rose by only 2.3 percent per year (Fig. 17).

Institutional, environmental, socio-economic, biological and technological factors were all influencing this pattern of expansion in world fisheries during this initial decade of Exclusive Economic Zones (EEZs). For example, technological advances, including the introduction of on-board freezing and processing, enabled fishing fleets to exploit fish stocks far away from home ports. The advent of

GROWTH IN GLOBAL MARINE CATCH

Source: FAO

synthetic twines and the mechanization of hauling gear led to the design of bigger and more durable nets while electronic fish detection and navigational aids increased the efficiency of the deployment of both fishing vessels and gear.

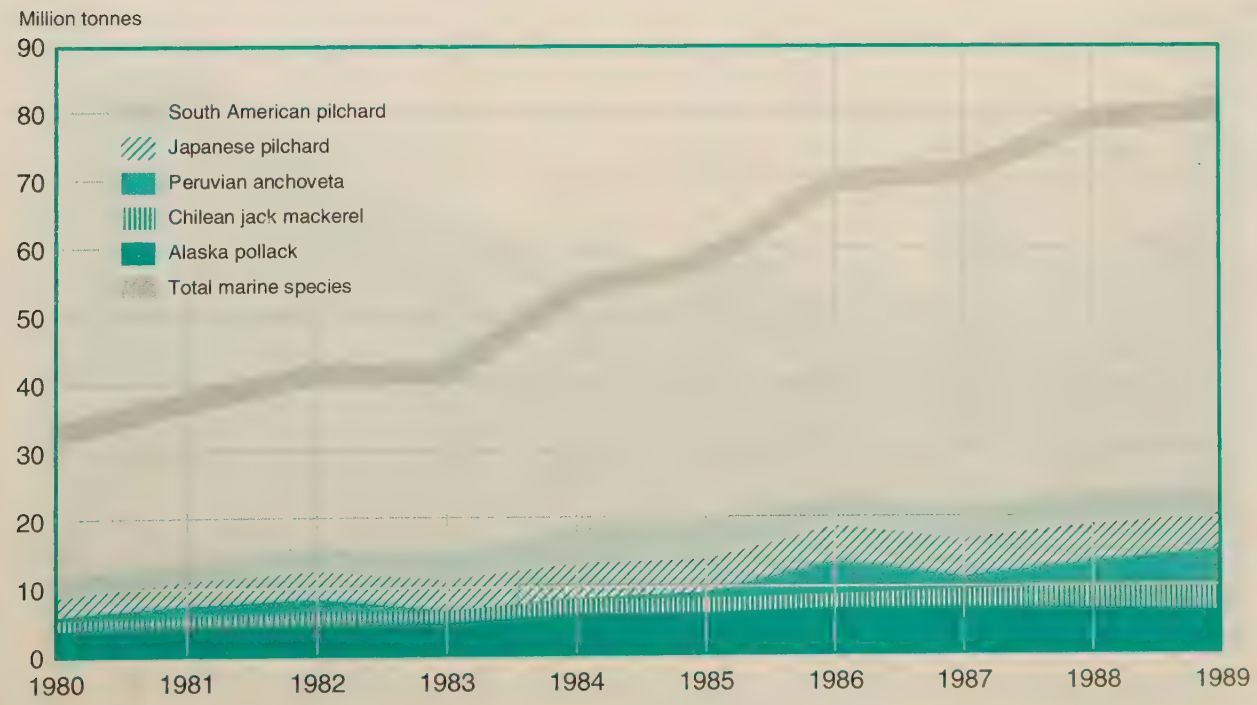
Five species accounted for most of the production increase during the 1980s. The catch of Alaska pollack, Chilean jack mackerel, Peruvian anchoveta, Japanese pilchard and South American pilchard increased from 12 million tonnes in 1980 to 25 million in 1989 (Fig. 18). The Japanese and South American pilchard share with the Peruvian anchoveta the characteristic of widely fluctuating yields as a result of natural variability. These stocks are expected to decrease in the future. Indeed, Japan's catch of Japanese pilchard dropped from 4.49 million tonnes in 1988 to 3.68 million tonnes in 1990.

These are also five relatively low-valued species. Alaska pollack has an average unit value of about one-third that of all other species. The average unit values of the other four species are about 10 percent of the overall average value while, together, the five species only contributed about 6 percent of the total value of production in 1989. Thus, the increase in the total catch of these five species makes a relatively low economic contribution to the growth in output.

Catch has also increased for higher-value species which are facing increased demand. The catch of all tuna increased fairly steadily during the past two decades, adding 1 million tonnes to the total annual catch between 1980 and 1989. The catch of skipjack and yellowfin tuna have increased at a rate of 5.4 percent and 4.5 percent per year, respectively, since 1970.

Skipjack stocks throughout the world are apparently abundant and have high rates of reproduction, which may allow significant increases in the global catch. Similar increases are less likely for yellowfin tuna and unlikely for the other major market species (albacore, northern and southern bluefin and bigeye). There have, however, been recent increases in the catch of albacore, particularly by Taiwan, Province of China, whose catch rose from an average level of about 60 000 tonnes during the period 1977-1985 to almost 140 000 tonnes in 1989. This was a result, at least in part, of the expanded use of large driftnets, a fishing technology capable of filtering great quantities

GROWTH IN CATCH OF MAJOR SPECIES



Source: FAO

of water on the high seas.

Shrimp are another group of species contributing to the increase in total marine catch. Total catch from all sources (marine and inland, capture and culture) rose from 1.1 million tonnes in 1970 to 1.7 million in 1980 and 2.4 million in 1989. The most dramatic increase occurred in China where total shrimp production rose fivefold over the two decades to reach more than 500 000 tonnes, or about 20 percent of total world output. In 1989, aquaculture accounted for about one-third of Chinese shrimp production. World production of shrimp by aquaculture in both fresh and marine water grew rapidly, reaching a total of 509 000 tonnes in 1989 (Fig. 19).

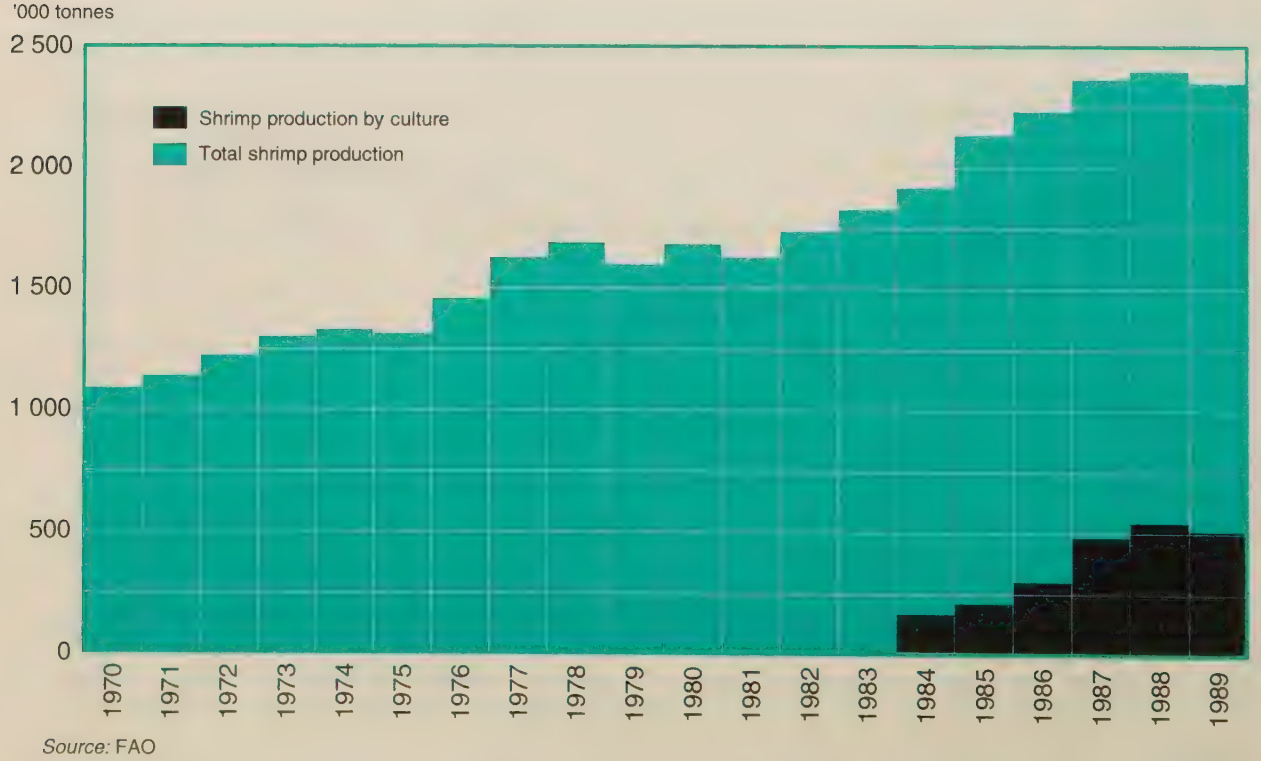
Salmon production was about 400 000 tonnes during the 1970s, reaching 600 000 tonnes in 1980 and rising to more than 1 million tonnes in 1989. This was a result of both the recovery of stocks through more effective conservation measures and production through aquaculture. Salmon production by acquaculture mainly began in Norway in 1980, with several other countries quickly following suit. Norway currently accounts for more than 25 percent of total salmon production. Prices of salmon have declined markedly as a result of increased production from both capture and culture fisheries (Fig. 20).

The significant overall increase in the global marine catch during the 1980s obscures a number of features that give cause for concern. First, there is little reason to believe that the global catch can continue to expand, except for increases that might occur through more effective management of stocks. The stocks that have accounted to a large extent for the recent growth are the small shoaling pelagics, such as sardines, pilchards and anchovies. These stocks are subject to wide fluctuations in biomass. Some of them are at the peak of their cycles and can be expected to decline in the future although, since others may increase to take their place, the aggregate catch is not likely to change.

Moreover, these species are mostly used for the production of fish-meal and have a low value, thus making a relatively small contribution to the global economy.

An aspect raising more concern is that of the continued overfishing of many individual stocks of fish. Although there are instances of stock rehabilitation through the adoption of

WORLD SHRIMP PRODUCTION



Source: FAO

conservation measures, these are relatively scarce in most areas of the world. The more general situation is one of depletion. The catch of four important species of groundfish (Atlantic cod, Cape hake, haddock and silver hake) dropped from 5 million tonnes in 1970 to 2.6 million tonnes in 1989 (Fig. 21). Because of overfishing, there have been significant drops in catches of Atlantic redfish, Pacific Ocean perch, yellow croaker, atka mackerel, Atlantic herring and Atlantic mackerel.

Most shrimp stocks throughout the world have been fished beyond the point of maximum sustainable yield (MSY). In many cases, the small size of the individuals harvested is not only leading to a lower total catch but also to considerable economic losses because of the lower prices received. In addition, the shrimp trawlers often take large quantities of trash fish, frequently accounting for up to 90 percent of their hauls. Some of the fish taken in these hauls are juveniles of species that would be of high value if landed as adults.

The depletion of various stocks of fish has occurred in virtually all coastal states throughout the world. Indeed, as discussed below, this is an inevitable outcome unless appropriate controls are adopted.

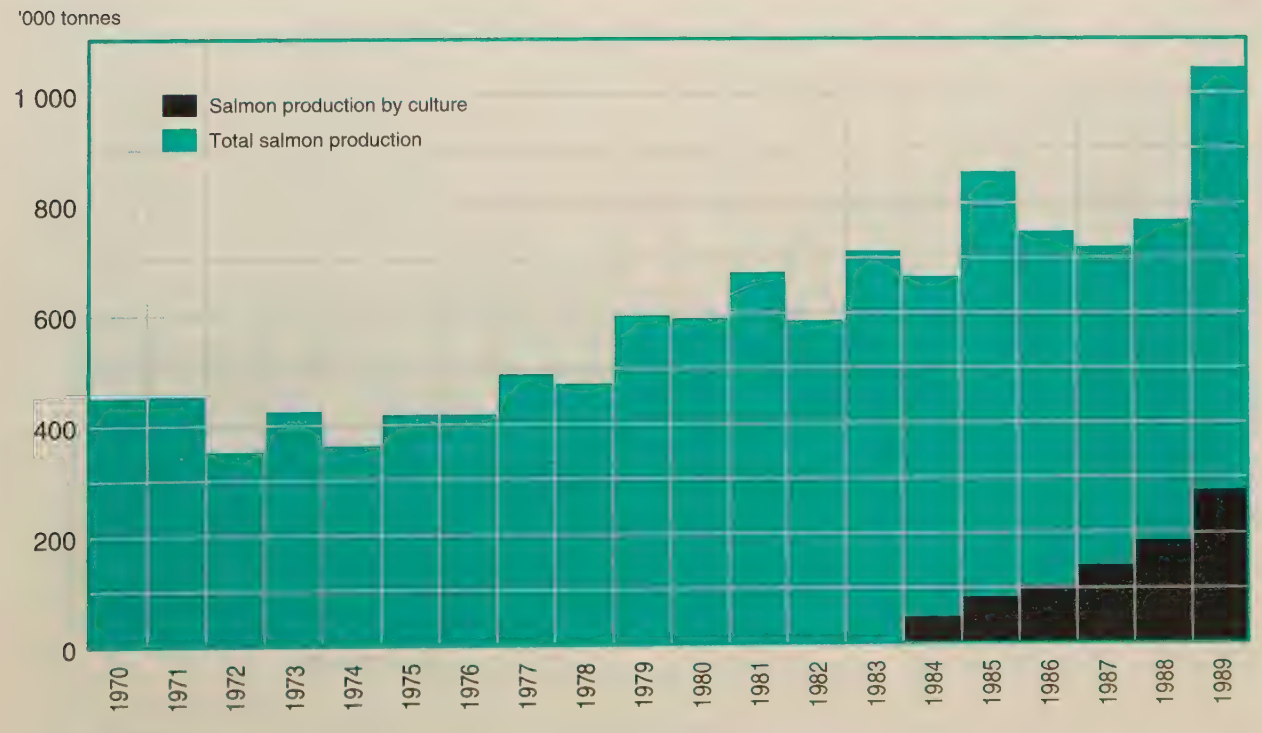
Catch by major fishing areas

Three types of areas attract distant-water fleets: *i)* areas of upwellings where deep, cold ocean waters rise to the surface, bringing with them abundant nutrients; *ii)* areas of extensive continental shelves (e.g. northeastern America); and *iii)* areas where tuna stocks may be found. Some tropical zones (e.g. the Indian Ocean, the South China Sea and the Caribbean Sea) are of lesser interest to the distant-water states because of the large diversity of species and relatively small size of individual stocks. The relative importance of the various fishing areas is shown in Fig. 22.

Rich areas of upwellings which have attracted the distant-water fleets are found in the eastern central Atlantic (off northwestern Africa), the southeast Atlantic and the southeast Pacific. In the eastern central Atlantic, the catch by developing coastal states has shown a consistent increase over the two decades. However, much of this catch has been taken under joint ventures with foreign fishermen who have avoided access negotiations and costs by adopting coastal state flags.

The southeast Atlantic contains similar stocks of shoaling pelagic species in addition to large quantities of demersal stocks of Cape hake. The

WORLD SALMON PRODUCTION



Source: FAO

coastal state catch has declined over the past two decades. A large portion of this region is off the coast of Namibia which did not claim extended jurisdiction until it acquired independence in 1990. This region has been marked by considerable overfishing of the Cape hake and pilchard stocks.

Until the mid-1970s, Peru dominated the southeast Pacific region. Chilean catches increased rapidly, growing from 1 million to almost 7 million tonnes by 1989. The former USSR entered the area significantly in 1979.

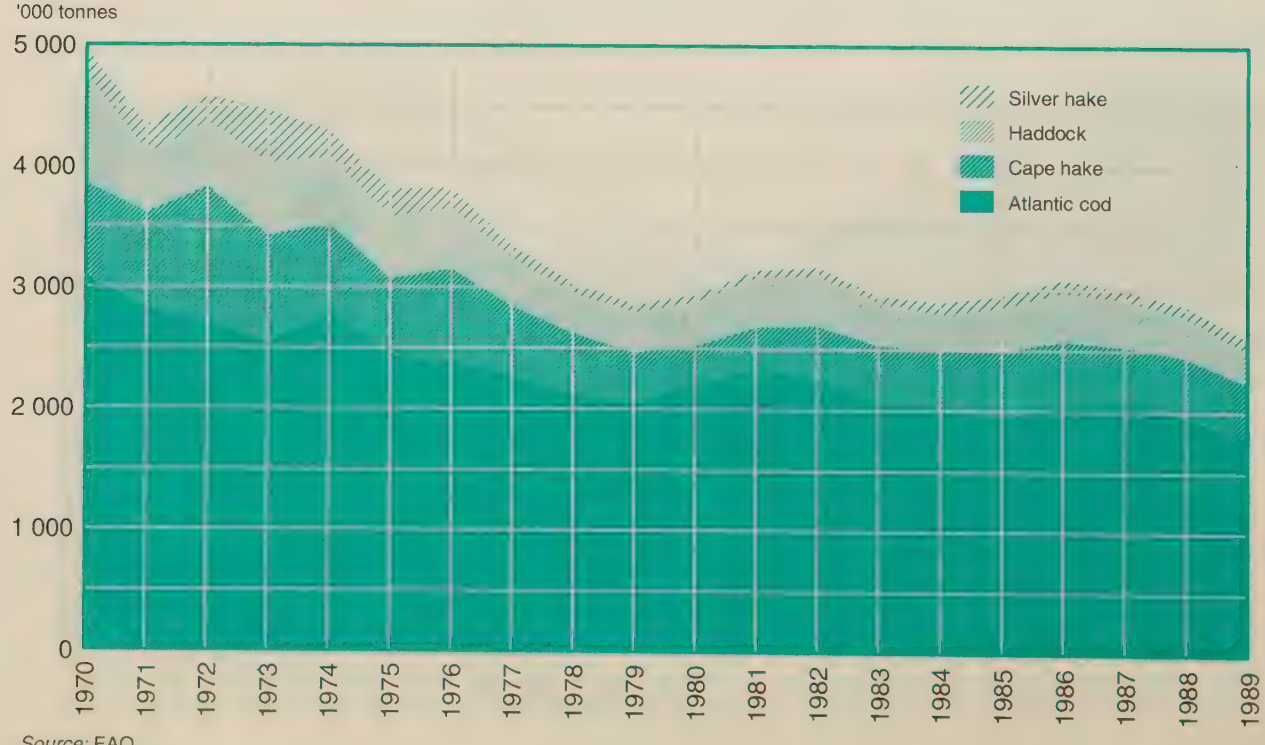
The coastal state catch is most significant in the southeast Pacific. In the eastern central and southeast Atlantic, the coastal state catch declined in the 1970s and increased in the 1980s. The increase was only moderate, however, and to some extent a result of the transfer of flags from the developed states.

The major areas of large continental shelves of interest to the distant-water states include the northwest and southwest Atlantic and the northeast Pacific, all of which experienced dramatic changes. In the northwest Atlantic, although total catch in this region has declined, the catch by the coastal states of Canada and the United States has increased since the 1970s.

In some regards, on the west coast of North America, the developments are similar to those on the east coast. To a large extent, the distant-water states have been replaced (in the catching sector) by the coastal states, particularly the United States. Here, however, there was a strong increase in the total catch during the 1980s, mostly made up of Alaska pollack. The former USSR's fleet virtually ended fishing operations by 1980 while the Japanese fleet continued into the 1980s, although with ever-decreasing catch levels. The former USSR and Japanese fishery activities remained, although in a different form. The former USSR, until recently, operated joint ventures under which its processing vessels purchased fish caught by its United States partners, while the Japanese have invested in joint ventures as well as in shore processing facilities.

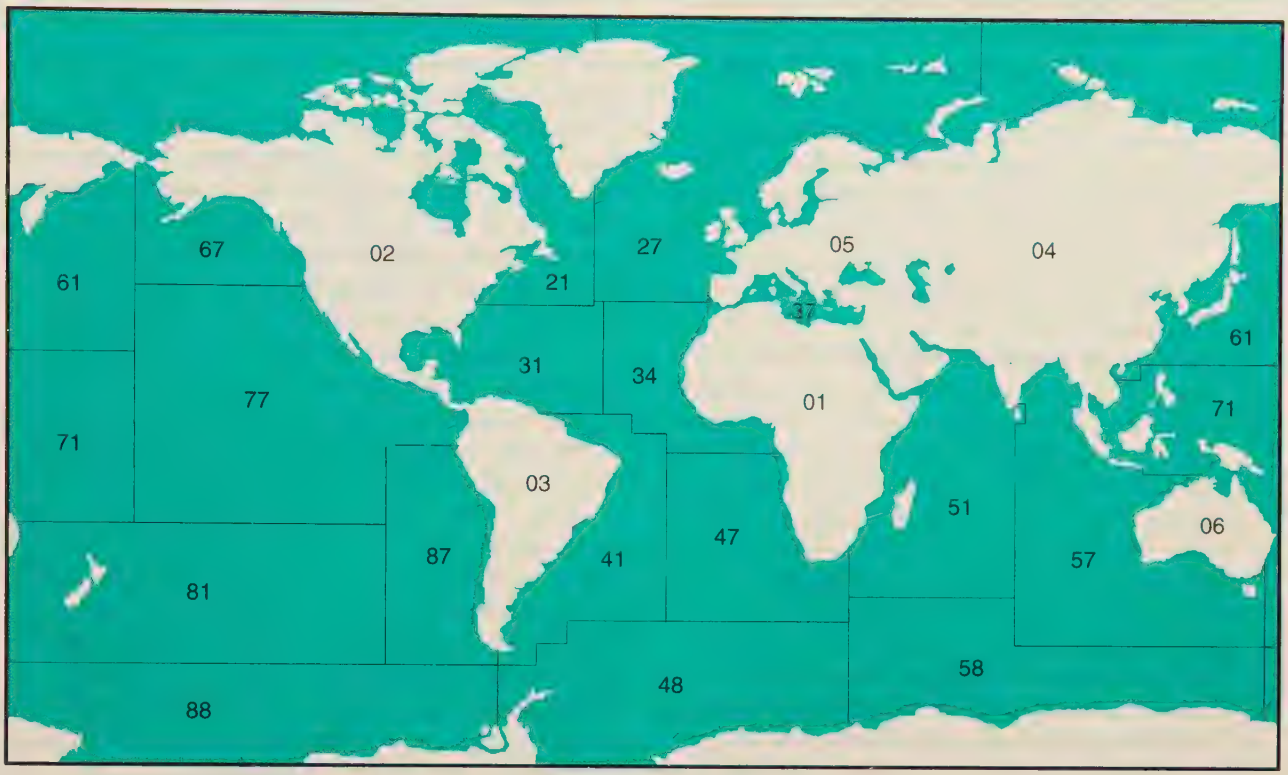
In the southwest Atlantic, an opposite development is taking place. In this region, the coastal states dominated fisheries during the 1970s. However, from about the middle of that decade, distant-water states entered the area and increased their catch from a negligible amount to 1 million tonnes, amounting to over 40 percent of the region's total catch. Over

WORLD CATCH OF SELECTED MAJOR GROUNDFISH



Source: FAO

NOMINAL WORLD FISH CATCH BY MAJOR FISHING AREAS



AREAS	INLAND FISHERIES	WORLD CATCH IN 1990 ('000 tonnes)
01	Africa	1 905
02	North America	537
03	South America	333
04	Asia	10 197
05	Europe (including former USSR)	1 448
06	Oceania	24
	TOTAL INLAND	14 444
	MARINE FISHERIES	
21	Atlantic, northwest	3 221
27	Atlantic, northeast	9 183
31	Atlantic, western central	1 697
34	Atlantic, eastern central	4 098
41	Atlantic, southwest	2 029
47	Atlantic, southeast	1 530
37	Mediterranean and Black Sea	1 489
51	Indian Ocean, western	3 376
57	Indian Ocean, eastern	2 828
61	Pacific, northwest	25 688
67	Pacific, northeast	3 428
71	Pacific, western central	7 311
77	Pacific, eastern central	1 519
81	Pacific, southwest	1 031
87	Pacific, southeast	13 945
88, 48, 58	Antarctic	428
	TOTAL MARINE	82 801
	GRAND TOTAL	97 245

Note: Including aquaculture but excluding aquatic plants
Source: FAO Yearbook Fishery Statistics: Catches and Landings 1990, Vol. 70

two-thirds of this distant-water catch is of newly discovered squid stocks and is taken by several distant-water states. The phenomenal increase in squid catches during the mid-1980s levelled off in the last three years as maximum limits were reached and controls were established over the catch.

Changes have occurred in other regions as well, although not generally of the same significance, with regard to distribution patterns between distant-water and coastal states.

Developments among regions and main fishing countries

Globally, *developing countries* have been increasing their marine catch (since the collapse of the Peruvian anchoveta fisheries in 1972) at a considerably faster rate than the developed countries (Fig. 23). The developing countries, which accounted for 27 percent of the world catch in 1950, now account for more than half the total. Unlike fisheries in the industrialized countries, their fisheries are dominated by small-scale or artisanal producers. Artisanal fisheries, typically using small boats and canoes, account for more than 25 percent of the world catch. They are the source of more than 40 percent of the fish used for human consumption.

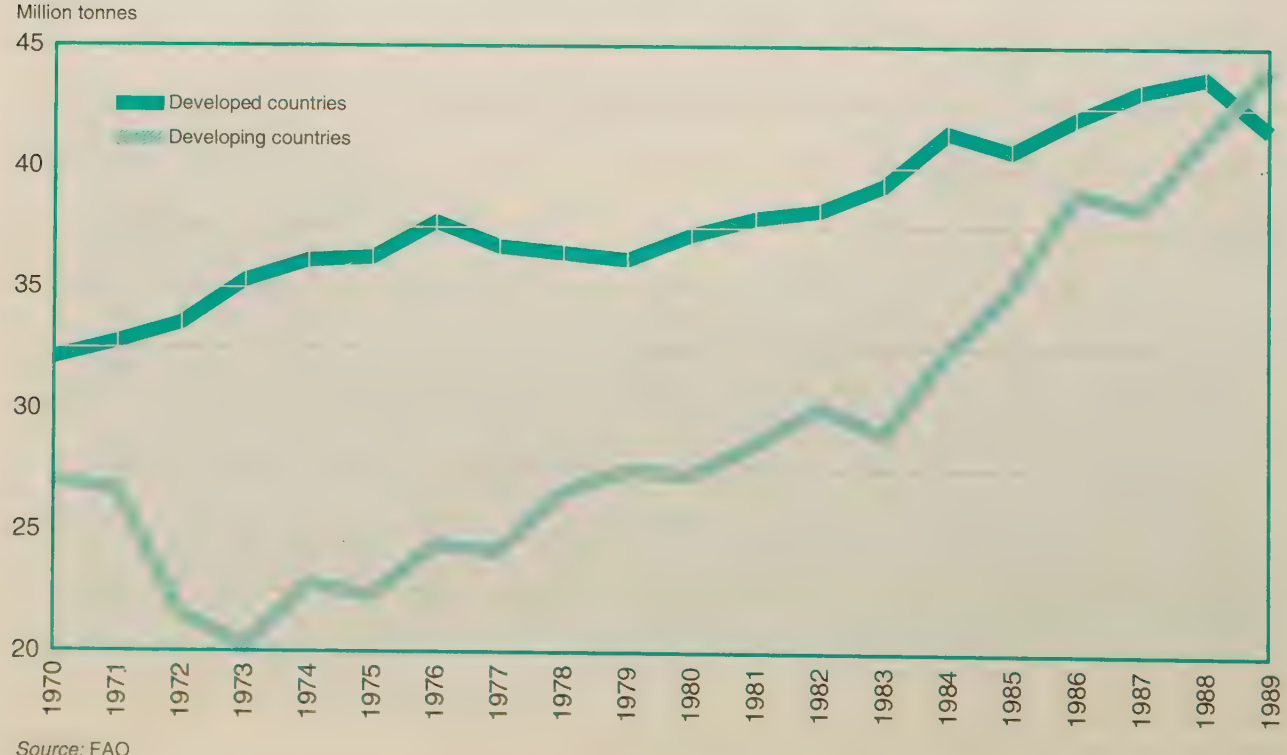
Among the 20 countries with the largest catch during the two decades, nine are developed and 11 are developing.[1] In each case there are three states with significantly larger catches than the others: Peru, China and Chile; and Japan, the former USSR and the United States.

With the significant exceptions of the Republic of Korea and Taiwan, Province of China, the catch of the developing countries is almost entirely within their EEZs. Thailand initially fished heavily in the zones of other Southeast Asian states but now does so only slightly. China, on the other hand, began fishing in the eastern central Atlantic in 1985 and in the northeast Pacific in 1986, although the amounts caught are still small.

China's catch in the northwest Pacific has grown rapidly, particularly since 1985 when its total catch rose from 3.9 million to 6.4 million tonnes. This

[1] The nine developed countries are Canada, Denmark, Iceland, Japan, Norway, the Republic of South Africa, Spain, the United States and the former USSR. The 11 developing countries are Chile, China, the Democratic People's Republic of Korea, India, Indonesia, Mexico, Peru, the Philippines, the Republic of Korea, Taiwan, Province of China and Thailand.

TOTAL MARINE CATCH BY DEVELOPED AND DEVELOPING COUNTRIES



Source: FAO

resulted, at least to some extent, from the relaxation of domestic price controls and the consequent incentive to deploy excess fishing capacity from national waters.

The Republic of Korea and Taiwan, Province of China take the greatest proportion of their catch in the northwest Pacific. Both, however, have increasingly extended their efforts into distant waters, reaching 20 and 25 percent, respectively, of their total marine catch. Most of the Republic of Korea's northeast Pacific catch, which peaked in 1986, is Alaska pollack. Both states have recently been taking large quantities of squid in the southwest Atlantic and tuna in the eastern and western central Pacific.

Among the developed countries, Japan maintains the lead but only because of the extremely large increase in its pilchard catch, which currently makes up 37 percent of the country's total marine catch. Japan's catch in distant waters has decreased and shifted significantly among the different regions over the past two decades, particularly since 1980. There was an extremely large decline in catches off the Pacific coast of North America but some increases occurred in other areas of the Pacific and the southwest Atlantic.

In terms of total tonnage, the former USSR continued to be the largest distant-water fishing country through 1989. Preliminary estimates indicate a decline in its total marine catch of about 1 million tonnes in 1990 and most analysts expect a continuing decline (see Box 11).

Similar patterns of decline have occurred for the East European countries. Their catches off North America declined significantly (although there were two periods of relatively high catches in the early and mid-1980s). In other regions, as in the case of the former USSR, there were large variations, with significant increases in the South Atlantic and northwest Pacific and declines in the eastern central Atlantic and northeast Atlantic. The mobility of the East European fleet is also indicated in the large changes in the composition of the catch.

It is apparent that the United States and Canada have taken advantage of the EEZs and significantly increased their proportion of the catches taken off their east and west coasts. On the east coast, although their share of the total rose from about 30 percent to about 40 percent each, there was only a moderate increase in absolute terms. In the Canadian part of the region, conservation controls to allow the rehabilitation of overfished stocks explain the moderate increase in catch.

On the west coast, the combined catch of the United States and Canada rose from about 20 percent of the total to more than 90 percent and there was a sixfold increase in tonnage, from 500 000 to 3 million tonnes, of which the United States accounted for about 90 percent. The United States also takes an additional 1 million tonnes from the western central Atlantic and smaller amounts from the eastern and western central Pacific. For the United States, gains on the west coast accounted almost entirely for the doubling of its marine catch during the two decades. Virtually all of this increase occurred from 1980 onwards. Although the major gain was in Alaska pollack, an almost equivalent increase occurred in catches of various whitefish (cod, hake, halibut, sole).

Spain remains one of the largest distant-water fishing nations. The proportion of its total marine catch taken outside the northeastern Atlantic and the Mediterranean remains at about 50 percent. During the 1970s, the significant declines in catches from the northwest Atlantic were made up by increases from the eastern central Atlantic. In the southeast Atlantic, large catches of Cape hake were maintained throughout the two decades but were curtailed in 1990 and 1991 by Namibia's acquisition of independence and its extension of jurisdiction and controls over foreign fishing. This should allow the overexploited stocks of Cape hake to recover.

In general, distant-water fishing declined during the 1970s but increased during the 1980s. Changes in catches by the major distant-water states are shown in Fig. 24. Although the Japanese non-local catch has diminished, catches by the other states either remained level or increased, particularly during the 1980s. This was achieved by significant shifts in areas of activity, i.e. moving to zones of developing coastal states where they could acquire access rights or to areas beyond national jurisdiction. Their major targets have become various species of tuna; cephalopods, particularly squid; and certain species that can be caught in large quantities at a low cost.

Fish resources distribution during the 1980s

Although the extension of national jurisdiction was critically important for all coastal states, in that it provided them with the exclusive right to manage the resources within their zones, it had a limited effect on the distribution of the seas'

BOX 11

The likely decline of the former USSR fleet

Although the political breakup of the former USSR is bound to have major consequences for fisheries, a much more significant development for the sector is the departure from a centrally planned economy. It is not yet clear which of the newly independent states will acquire the fishing vessels. Although the Russian Federation may maintain the lion's share of around 80 percent because of its ports in Murmansk, Kaliningrad and Vladivostok, other states have placed their flags on vessels based in the Baltic and Black Seas. In all cases, however, it is the change in the economic regime that will dominate developments in the sector. Some speculation regarding its likely effects is worthwhile because of the significance of these states' catches for particular regions.

The decision to expand the former USSR fishing fleet during the 1960s was based on a resource allocation methodology that was very different from an allocation system based on market prices. In the former USSR, policy-makers compared the quantities of fish protein that could be obtained per unit of labour and capital with the quantities of protein that could be obtained from meat. The analysis concluded that the production of fish would use about half as much capital investment, one-third of the production costs and one-quarter of the labour requirements compared with those required for the production of an equivalent amount of meat.

Over time, this decision process led to an increasingly uneconomical fishing sector. By 1989, estimates indicated that operating expenses were around US$ 10 000 million to US$ 13 000 million per year.[1] The marine catch of 10 million tonnes, over half of which is composed of low-value pelagic species, would indicate gross revenues of perhaps US$ 5 000 million at the most. Thus, the annual operating deficit would amount to US$ 5 000 million to US$ 8 000 million, which would be considerably greater with the inclusion of capital costs. Although the fleets of many other countries are also operating with large deficits, their economies (for better or worse) can sustain high subsidies.

The demand for fish as a source of animal protein is high in the former USSR. Subsidies may continue, although most likely at a greatly diminished rate. It is likely that the subsidies will go to the smaller vessels operating in relatively near shore waters and that the costly, high fuel-consuming distant-water vessels will largely disappear. Since there are few opportunities to increase catches in the Baltic Sea, the Black Sea and the Mediterranean, any future effort will probably focus on the northern part of the North Sea and the northwest Pacific. Some distant-water fishing may continue to take place through joint ventures with developing countries.

A large part of the decline is likely to take place in three areas: the eastern central and southeast Atlantic and the southeast Pacific, where the USSR catch in 1989 amounted to about 3 million tonnes. In the eastern central Atlantic, the coastal states (particularly Morocco) should benefit to some extent by the diminution of the former USSR fleet. Since most of the stocks are

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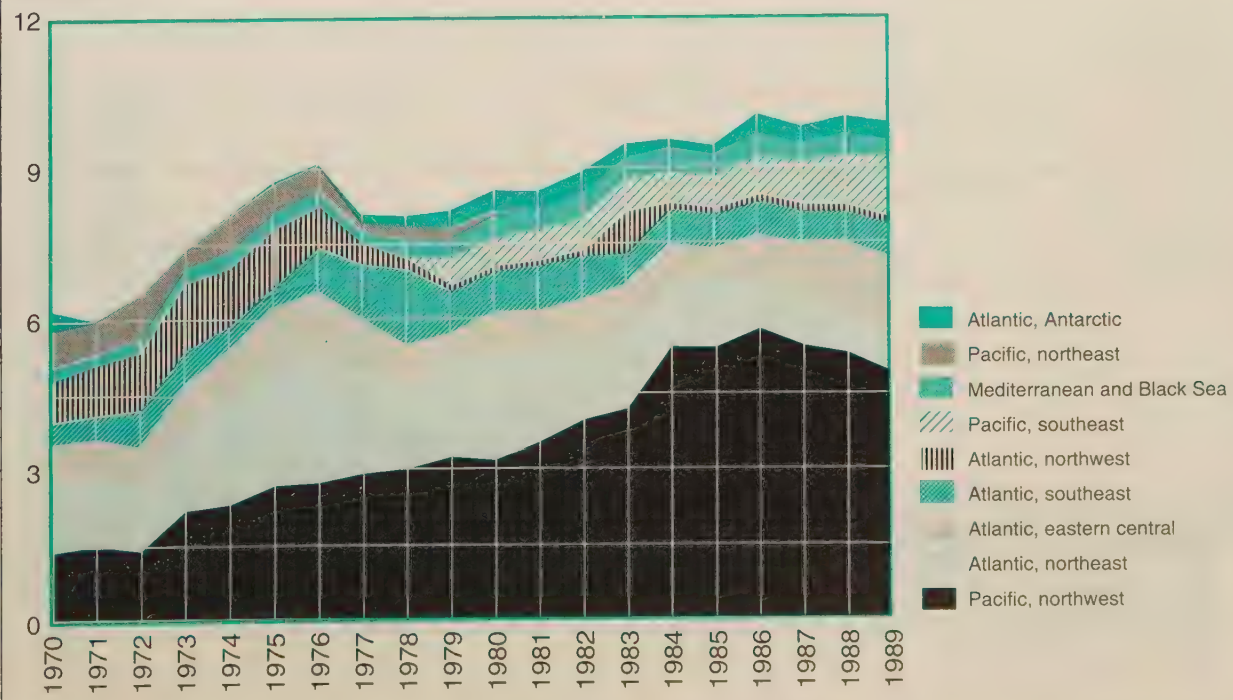
[1] See S.V. Mikhailov. 1962. On the comparative efficiency of production of some pro-ducts of the land and sea. *Okeanologiia*, 2(3): 385-392. Translated by W.G. Van Campen, Bureau of Commercial Fisheries, United States Department of the Interior. Paper prepared "in connection with a discussion of decisions on the 22nd Congress of the CPSU".

currently fully exploited, the gains would come in the form of increased catches per unit of effort. Any attempts by the coastal states to expand their capacity in order to replace that of the former USSR should proceed with extreme caution in view of the low prices of the species and wide variability in size of the stocks.

Thus, in the southeast Atlantic, the stocks of horse mackerel are in relatively good shape but the replacement of the former USSR fleet by domestic vessels is likely to be a slow process because of market constraints. Increases by the Republic of South Africa and, eventually, Namibia are possible. For the southeast Pacific, Chile has rapidly expanded its catch of the jack mackerel and could probably replace the former USSR catch in the next few years.

Overall, assuming a 75 percent decline in the former USSR catch in distant-water areas, a total drop in the catch from 10 million to 7 million tonnes could be expected. Pressures to increase catches in local waters will be intense but the opportunities to do so, particularly for Alaska pollack, are limited. Therefore a significant decline in the availability of animal protein to the former USSR and other countries, particularly in West Africa, is likely to occur. The likely increase in prices for small pelagic species could induce a more rapid development of coastal fisheries in West Africa.

FORMER USSR MARINE CATCH IN NINE MAJOR AREAS



Source: FAO

wealth because of the relatively few countries affected. Although some observers considered that the extension of jurisdiction would lead to a major redistribution of the seas' wealth in fisheries, the results have been mixed.

Fishery resources are of considerable local importance to a large number of countries but more than 80 percent of the global catch is taken by 20 countries (Fig. 25). In 1989, two states alone (Japan and the USSR) took 25 percent of the total marine catch; the next four countries took 30 percent; and the following 14 another 25 percent. The remaining coastal states shared less than 20 percent of the total marine catch.

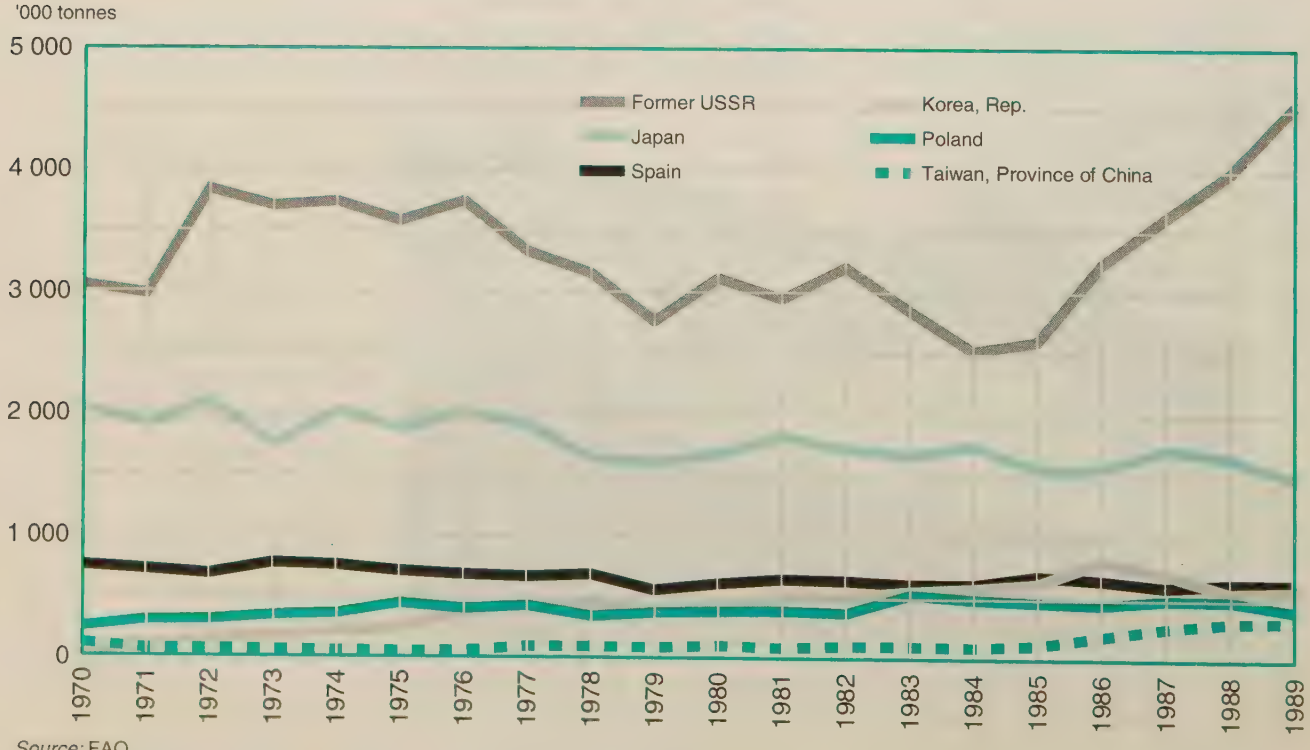
In the special chapter of *The State of Food and Agriculture 1980* it was noted that potential gains would accrue to the relatively few states whose zones contained large or valuable resources that attracted the vessels of distant-water fleets; and to a number of coastal states whose zones contain tuna stocks (mostly the South Pacific island states). Among the dozen coastal states that stood to gain large resources by the extension of jurisdiction, the United States emerged as the single largest gainer (although all coastal states achieved gains in terms of management authority). Furthermore, for those states that have acquired jurisdiction over large fish stocks, the gains varied greatly according to the value of the species.

Whatever the impact of the establishment of EEZs, however, changes in the distribution of the seas' wealth in fisheries cannot be considered solely in terms of quantities of catch. As discussed below, a country's benefits or losses should be measured in terms of the net profit to the national economy.

For several developing countries, however, the extension of jurisdiction did represent significant gains in terms of economic revenues and other benefits extracted from the distant-water states. For instance, under an agreement with the EEC, Morocco received about US$ 80 million per year for three years for allowing Spanish vessels to fish in its EEZ.[2] EEC payments to African countries for 1991 include US$ 20 million to Senegal, US$ 12.9 million to Mauritania and US$ 12 million to Angola. The South Pacific states have received US$ 60

[2] *Official Journal of the European Communities.* L 99, 16 April 1988, Vol. 31, p. 61. Protocol No. 1.

NON-LOCAL CATCHES BY SIX MAJOR DISTANT-WATER STATES



Source: FAO

million from the United States to allow that country's vessels to fish for tuna within their region for a five-year period. However, the great majority of developing countries have not received financial payments for access to their EEZs, since the resources within their zones have been of little interest to distant-water states.

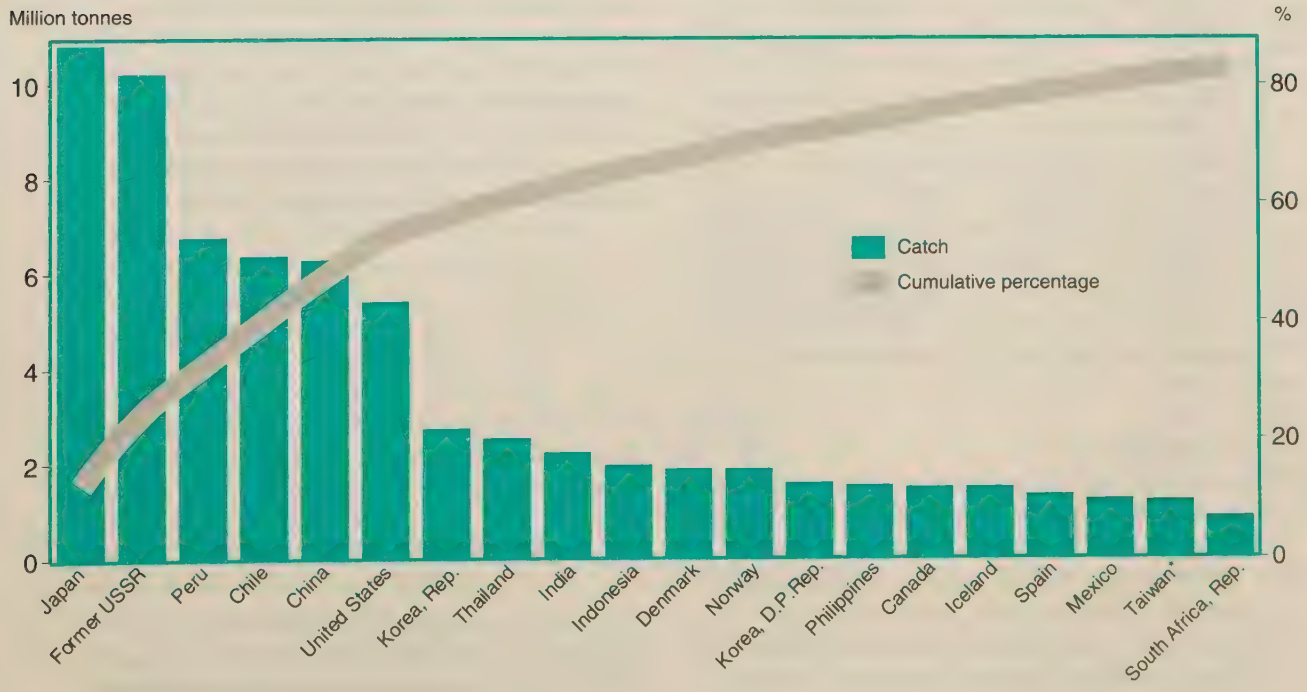
Similar to two decades ago, only a few countries are currently engaged in extensive distant-water fishing. In 1970, six states — the USSR, Japan, Spain, Poland, Portugal and the Federal Republic of Germany — took over 85 percent of the total catch by states in FAO statistical areas outside their own.[3] In 1989, the six largest distant-water fishing states took almost 90 percent of the total non-local catch. They were the same states, except that the Republic of Korea and Taiwan Province of China, replaced Portugal and the Federal Republic of Germany. The USSR, Japan and Spain alone accounted for three-fourths of the total in both periods. The total non-local catch by all states rose from 7.5 million to 9 million tonnes from 1970 to 1990 but dropped as a percentage of global marine catch from 13 to 11 percent. There have been, however, mixed effects among the major states and a generalized increase in the costs of distant-water fishing.

For Japan, retrenchment of distant-water fishing began to take place prior to the extension of jurisdiction, primarily in response to rising labour and fuel costs. Instead, joint ventures were formed with the processing sectors of other countries. In addition, as a result of extensions in jurisdiction, the Japanese have reduced the number of vessels authorized to fish in order to maintain catches per vessel. In the North Pacific, for example, the number of large mother ships and trawlers dropped from about 260 to 100 between 1983 and 1987 while the catch per vessel rose from 4 600 to more than 9 000 tonnes in order to allow for increased operational costs.[4]

[3] This is measured in terms of catch by states in FAO statistical areas other than those on which they border. It does not, therefore, fully reflect catches in foreign EEZs.

[4] O.S. Stokke. 1991. Transnational fishing: Japan's changing strategy. *Marine Policy*, 15(4): 235.

CATCH BY 20 MAJOR STATES
AND CUMULATIVE PERCENTAGE OF TOTAL MARINE CATCH IN 1989



Source: FAO

* Province of China

For the USSR, Poland and other East European countries, the extensions meant the loss of free access to a large quantity of stocks. This forced these countries either to negotiate financial arrangements with coastal states or to move to underexploited stocks on the high seas, such as Chilean jack mackerel and Antarctic krill. While the extension of jurisdiction added to their fishing costs, the major problem they now face is a big reduction in financial resources to pay the subsidies that were necessary to support their distant-water operations. Romania has scrapped 20 of its 46 distant-water trawlers while Bulgaria has scrapped five out of 15.

The distant-water catches of Spain and France have not changed significantly. Spain's catch in non-local areas in 1989 was only 15 percent less than that of 1970. The catch by French vessels dropped during the 1970s but increased during the 1980s, the net result being an overall increase of 19 percent for the two decades. A large part of this increase was a result of the expansion in tuna catch in the western Indian Ocean. For both of these countries, the costs of acquiring access to foreign (mostly African) zones are to a large extent borne by the EEC which negotiates agreements on their behalf. Among the other European states, Italy's non-local catches did not change significantly during the two decades while those of both the Federal Republic of Germany and Norway declined sharply from about 200 000 tonnes to about 10 000 tonnes and those of Portugal were halved from 200 000 to 100 000 tonnes.

With its small coastline, the Federal Republic of Germany was particularly hard hit by the extension of jurisdiction. Domestic production as a share of domestic consumption fell from 77 percent in 1970 to 43 percent in 1980 and to 28 percent in 1989. The tonnage of deep sea vessels with freezing and processing facilities fell from 117 000 gross register tons (GRT) in 1970 to only 21 000 GRT in 1990. This major structural adjustment was accomplished with government support for the retirement of vessels.

Coastal states

Losses in quantitative terms are not necessarily equivalent to losses in economic terms, not only because of differences in value of the species harvested but also because the open access condition that previously existed induced wasteful fishing practices. Where stocks have been fully fished, controls by coastal states to reduce the number of foreign fishing vessels can lead to increased average catches for those vessels that are allowed to remain in the fishery. For example, the cephalopod (squid, cuttlefish and octopus) fishery off Morocco has been so heavily overfished that a reduction in the number of vessels (and total costs) would allow the rehabilitation of stocks and, ultimately, higher total catches as well as revenues. This would lead to considerably higher catches per vessel that remained in the fishery. At the same time, an estimated US$ 250 million per year in surplus profits could be extracted by Morocco in the form of fishing fees.[5] In essence, it is in the interest of both the coastal states and distant-water fishing fleets to reduce excess fishing capacity and thereby achieve greater economic efficiency.

The coastal states could levy user fees directly on the foreign vessel owners to obtain greater economic benefits. However, when the costs of access are not borne by the fishermen but are paid by their governments (e.g. the EEC and the United States), distant-water fishermen have no incentive to discontinue overfishing the coastal states' stocks. If a coastal state negotiates access agreements that include the authorization of numbers of vessels, by limiting the number of vessels, those who acquire licences may receive higher catches per unit and obtain higher profits.

Much of the existing European distant-water fleet is the product of high subsidies together with increasing restrictions on overfished stocks in the domestic European waters. This has resulted in a surplus fishing capacity and pressure for access to foreign zones. The problems facing these fleets may, therefore, be due as much as, or more, to the failure to achieve effective fisheries management than from the extension of national jurisdiction.

[5] FAO. 1989. *La pêcherie céphalopodière marocaine: modélisation bio-économique et propositions d'aménagement.* Projet PNUD/FAO MOR/86/019. Rome, FAO.

FISHING COSTS AND REVENUES

As referred to above, an assessment of the state of economic health of the industry cannot be confined to changes in physical outputs but must include an evaluation of costs and revenues. Such an evaluation is difficult to do, however, because of data limitations (see Box 12). Nevertheless, the general perception that the industry is incurring massive deficits on a global basis underscores the need to quantify the scale of the problem.

Fishing costs

Over the past several years, FAO has requested fishing countries to provide information on the size of their fishing fleets.[6] Most developed countries with large fishing fleets provide data showing the numbers of vessels by size class and gear type. For these countries, the estimates are believed to be relatively accurate for vessels over 100 GRT in size, but much less so for smaller craft. For many developing countries, the task of acquiring the information is even more difficult and the estimates are less certain. Since there are a few significant gaps in the provision of information by developed countries (e.g. from the United States) as well as general deficiencies in the data from developing countries, the totals are considered to underestimate the full fishing capacity. Therefore, the calculations of costs are likely to be quite conservative.

Appendix 1 provides detailed information outlining how costs have been calculated for the construction of fishing vessels, replacement costs of the global fishing fleet, fuel costs, maintenance and repairs, insurance, supplies and gear, labour and capital.

The total annual operating costs of the global fishing fleet for 1989 is US$ 92 200 million, without including returns to capital or allowances for debt servicing. Annual routine maintenance is estimated to be US$ 30 000 million; insurance is US$ 7 000 million; supplies and gear are US$ 18 500 million; and fuel costs are US$ 14 000 million. Appendix 1 provides two estimates for annual labour costs with a lower estimate of US$ 22 600

[6] See *Bulletin of Fishery Statistics. Fishery Fleet Statistics 1970, 1975, 1980-89*. No. 30. Rome, FAO. 1991.

TABLE 21

Estimated total landed value of marine catches, 1989

Species/species group	Marine catch	Average unit value	Total value
	('000 tonnes)	(US$/tonne)	(US$million)
Salmon and salmonoids	936	3 500	3 278
Flatfish (flounder, plaice, sole, etc.)	1 193	2 900	3 459
Atlantic cod	1 783	1 068	1 904
Alaska pollack	6 259	331	2 072
Norway pout	350	87	30
Blue whiting	663	66	44
Other cod, haddock, hake	3 776	918	3 467
Sand eel	1 135	90	102
Other redfish, bass, conger	4 705	1 890	8 893
Capelin	898	100	90
Jack mackerel	3 655	90	329
Other jack, mullet	4 548	720	3 275
Japanese pilchard	5 112	203	1 038
South American pilchard	4 196	90	378
Atlantic menhaden	357	101	36
Gulf menhaden	583	90	53
Japanese anchovy	313	200	63
Anchoveta	5 408	90	487
Other herring, sardine	8 630	200	1 726
Tuna	3 985	1 700	6 775
Chub mackerel	1 671	260	434
Atlantic mackerel	626	270	169
Other mackerel	1 519	370	562
Shark	684	750	513
Miscellaneous marine	10 019	760	7 615
Crab	1 164	3 600	4 189
Lobster	202	11 270	2 275
Squat lobster	5	3 350	15
Shrimp *	1 841	4 000	7 370
Other marine crustaceans	35	3 000	107
Abalone *	85	4 960	423
Oysters *	80	3 026	242
Mussels *	213	1 260	269
Scallops *	529	2 760	1 461
Clams *	993	1 025	1 018
Squid, cuttlefish, octopus	2 545	2 100	5 344
Miscellaneous marine molluscs	216	950	205
TOTAL	80 910		69 704

(*) Indicates species produced in aquaculture. Quantities produced by aquaculture for salmon and shrimp are not included (these quantities are shown in Fig. 3 and 4) but the production influences average unit value for these species.

Source: FAO.

million.

Based on 1989 gross revenue of around US$ 70 000 million (Table 21), the annual operating deficit is estimated to be approximately US$ 22 000 million without considering the cost of capital.

While some debt servicing costs can be at preferentially low rates, particularly those provided through international finance institutions and bilateral assistance, in most cases the debt servicing charges are at least equal to commercial rates, and have been high. With a replacement value of US$ 320 000 million, the return to capital would at least have to equal opportunity costs, which, since there are limited opportunities for converting fishing vessels to other uses, may be lower than other maritime practices and can be set at 10 percent for this exercise. The resulting costs for the fleet would increase by US$ 32 000 million for a deficit of about US$ 54 000 million. In general, an allocation of 17 percent of revenues is the minimum required to cover debt servicing, depreciation and profit margins.

BOX 12

Fisheries data

Collecting fisheries data is extraordinarily difficult. Several special characteristics distinguish the task from that of collecting data on other natural resource industries. Fish in the sea are not readily countable both because of the opacity of the medium and their tendency to move.

Another basic problem is the sheer number of species and countries involved. FAO currently collects data on 995 species from 227 countries and administrative or political entities (including small islands such as the Christmas and Norfolk Islands). Data on catches are collected in 30 statistical regions (inland and marine).

The information on catches is provided to FAO by individual countries, many of which are unable to devote the resources necessary to perform the task adequately. A large portion of many developing countries' catches is landed on isolated beaches along extensive coastlines. The coastline of the state of Kerala in India is only 600 km long (about 8 percent of the total Indian seaboard) but has 220 recognized landing places. Indonesia stretches over a distance of some 5 000 km and has more than 13 000 islands.

In addition to the difficulties of collecting catch data, there are also problems concerning the falsification of data, mostly, although not entirely, by fishermen of developed countries. Fishing operations often take place far out to sea where they are not readily observable. Certain management measures, particularly those limiting the quantities of catch, induce fishermen to underreport their catch or take other measures to avoid compliance. The enforcement of such measures is extremely difficult. There are other situations where overreporting of catches has been known to take place in attempts to increase the importance of fisheries to the national economy.

Aside from the simple measuring of quantities of catch, there are also considerable difficulties in estimating revenues. Individual species vary widely in value, ranging from species used for fish-meal, at less than US$ 100 per tonne, to luxury species such as lobsters, at more than US$ 10 000, or bluefin tuna for sashimi, at US$ 20 000 per tonne. Furthermore, for any particular species, prices vary with regard to size, quality, points of landing, season and even time of landing during the day. Many of these variations are a result of the high degree of perishability of most fish species. Accurate information on fish prices at points of landing is rare.

It is equally difficult to obtain accurate information on fishing costs. Simply in terms of numbers of fishing units, the problems are difficult. For example, in the state of Kerala, a detailed survey carried out

Revenue

Estimates of the gross revenues received by fishermen are also difficult to make. On the basis of scattered information, FAO has derived rough indicators of the average unit values in 1989 for the major species and species groups (Table 21). Where possible, estimates for individual species caught in large quantities are provided and they are believed to be relatively reliable (e.g. Atlantic cod, Alaska pollack, Norway pout, sand eel, capelin, Japanese pilchard). For several of the other groups, there is a degree of uniformity in the unit value of the dominant component species (shrimp; salmon; tuna; squid, cuttlefish and octopus; lobster; clams and other molluscs). Other groups, however, contain numerous species for which there are extreme differences in price (redfish, jack, mullet and mackerel). In these cases, an attempt has been made to provide a weighted average unit value.

An additional caution needs to be expressed: the estimates are based on 1989 information. Since prices vary from year to year, the degree

in the early 1980s estimated about 30 000 fishing craft, mostly non-mechanized types, and about 3 000 mechanized gillnetters and trawlers.[1] These included 22 different combinations of vessels and gear.

In addition to the large numbers involved, there are problems in obtaining costs of the various inputs. Estimates of capital costs are obscured by the informal credit markets in many developing countries and the high and diverse kinds of subsidies in developed countries. Labour costs are difficult to estimate because most fishermen are paid through a system under which total catch is divided into shares for the boat, the gear, the operating costs and the crew members' wages according to their position. The costs of fishing gear, supplies, insurance, fuel and maintenance can be obtained for the large-scale vessels of developed countries but are not readily available in most developing countries.

FAO, with the help of regional fisheries bodies, has made a considerable contribution to developing standardized reporting forms and providing these to states, often with training programmes. The Organization is the sole repository of information on global fisheries. However, its efforts have been primarily (although not entirely) focused on quantities of catch and, only recently, has it attempted to expand the acquisition of data on costs and revenues, which are vital for implementing improved fisheries management.

FAO, however, must rely on individual states to provide the necessary data. Fisheries cost and price information is not a high priority for most states at present, largely because the value of such information is not readily evident to administrators. In the absence of controls over access, very little can be done to improve the contribution of fisheries to national economies while the resources themselves have no marketable value. The demand for economic information is relatively low compared with the costs of supplying it.

However, where access controls are in place, demand increases. For example, in the northern Australian prawn fishery, managed by a limited entry programme, the fishermen, themselves, pay for information that tells them when to move from one area to another in order to focus their efforts on the larger and higher-priced prawns.

As in the case of catch data, FAO can play a useful role in providing advice and training on the collection of economic data. This, together with advice and training on improved fisheries management practices, will lead to greatly improved fisheries data.

Current difficulties in the acquisition of fisheries information indicate that the estimates of catches, values and costs contained in this chapter must be considered as imprecise. However, for some of the more important points made, the estimates may be relatively reliable since they relate to a few countries taking a large percentage of the total production and value and involve a small number of species. Furthermore, although absolute figures may be rough estimates, the relative values and overall trends are considered satisfactory for evaluating major issues.

[1] FAO. 1982. *Economics of artisanal and mechanized fisheries in Kerala. A study on costs and earnings of fishery units.* FAO/UNDP Project in Small-Scale Fisheries Promotion in South Asia. Working Paper No. 34. Madras, FAO.

TABLE 22

Estimated landed value of major species and species groups, 1989

Species group	Landed value	Percentage of total
	(US$ million)	
Shrimp	7 370	11
Tuna	6 775	10
Cephalopods	5 344	7
Crab	4 189	6
Salmon	3 278	5
Lobster	2 275	3
Alaska pollack	2 072	3
Atlantic cod	1 904	3
TOTAL	33 207	48

to which they represent the present situation may be questioned. It is known, for example, that prices of salmon have declined significantly in the past two years because of the large culture production and abundant catches in the North Pacific. For the most part, however, the estimates presented are believed to be a fair reflection of relative values.

Given these words of warning, it is still possible to make a general point: a relatively few species account for a large proportion of the total value of the marine fisheries catch.

Table 22 shows that eight species and uniform species groups make up almost 50 percent of the total value. Moreover, with the exception of Alaska pollack, all of these have high unit values — more than U$1 000 per ton. These species are also the ones for which there is likely to be the largest amount of economic overfishing, as discussed in the section Fisheries management, p. 174.

It is noteworthy that, on a global basis, the fishing industry shows evidence of high concentration. A few countries account for the greatest amount of catch and incur the largest proportion of costs while a few species make up the largest amount of value. There is no evidence, however, of a general concurrence of these concentrations. The vessels of the former USSR, for example, contributed greatly to the total fishing costs and harvested a large share of the total world catch but their catch was mostly made up of low-valued species (including Alaska pollack). Furthermore, shrimp, which is the most valued species group, are caught by a large number of countries, only a few of which have industrial fleets.

A comparison of estimated gross revenues of marine catch with the estimated costs of the global fishing fleet produces a remarkable conclusion. These calculations indicate that the *annual operating costs of the global marine fishing fleet in 1989 were in the order of US$ 22 000 million greater than the total revenues*, with no account being taken of capital costs. Although the calculations are tentative, they still suggest that global marine fisheries may be incurring very significant losses.

There are several reasons why this situation may be possible. One is the condition of open access which still persists on the high seas and, in most states, for the domestic fleets within national economic zones. Where this condition exists, fleet size (and capital investment) will tend to be greater than that required to take optimum yields from the stocks. Open access provides an incentive to overcapitalize (see Box 13). Although, with the extension of limits, foreign fishermen no longer have free and open access, overcapitalization may still be significant because access fees are generally paid by governments rather than by the fishermen. Fishermen therefore have no incentive to reduce their fleets.

Overcapitalization is exacerbated by the ease of entry into fisheries and the difficulties of exit. When prices rise or stocks are abundant, new vessels are built, but when prices or yields drop and there are no alternative opportunities for employment of the vessels, they remain in the fisheries as long as they are able to cover their direct operating costs. When the owners can no longer cover such costs, they often sell their vessels to fishermen in other fisheries or in other countries.[7] The scrapping of fishing vessels tends to be delayed well beyond the time of scrapping in most other maritime industries; that is generally not until refit costs approach the costs of a new vessel.[8]

This situation may be particularly significant for the large vessels of many distant-water fleets. These fleets have been sufficiently mobile to move from one ocean region to another as the abundance of the stocks has changed because of overfishing or natural variations. Yet,

[7] Several countries have legislation preventing the import or export of used vessels.

[8] Refit costs are defined as the costs required to bring the vessel back into full operational service.

such alternative opportunities for the employment of the fleets have become increasingly restricted as overfishing has become more pervasive.

Another reason for the large deficit is that the fishing industry is heavily subsidized in many countries. It has already been noted that massive subsidies supported the former USSR fleet as well as the fleets of East European countries. These subsidies account for only a portion of the total deficit when capital costs are included, however. In Japan, the Japan Fisheries Association noted that "the current credit balance extended to fisheries from both the commercial and government sectors is about US$ 19 000 million".[9] It also stated that, "in order to support business entities in financial

[9] Japan Fisheries Association. 1991. *Fisheries of Japan.*

BOX 13

The economic consequences of open access

The economic theory of common property natural resources explains why an uncontrolled fishery tends to attract excessive amounts of capital and labour and why it may be fished beyond the point of maximum sustainable yield (MSY), a biologically determined quantity. At different levels of fishing effort (numbers of vessels or fishermen) maintained over the long term, a particular stock of fish will produce different levels of sustainable yields (Diagram 1, p. 150). The yields increase in response to greater amounts of fishing effort up to the point of the MSY. For some stocks, fishing beyond that point depletes the stock so that subsequent yields are lower than the maximum, although the fishing effort has increased. For other stocks, depletion may not occur so rapidly and the MSY can be achieved over a wide range of fishing effort. However, excessive amounts of capital and labour will still be employed.

The total catch curve can also represent total revenues to the fishery on the assumption that varying sizes of catch do not affect average prices received. The total cost curve is shown as a straight line, based on the simplified assumption that every additional unit of effort has equal costs.

With open access, the fishery reaches equilibrium when total costs and total revenues are equal (at point E). At any amount of fishing effort below that point, average revenues are greater than average costs, thereby attracting other fishermen into the fishery.

The principle of economic efficiency suggests that the fishery operate at the point of maximum net revenue (MNR), where the cost of the additional unit of effort is equal to the additional revenue it produces; that is, where marginal costs and marginal revenues are equal.

With the extension of jurisdiction, many stocks now come under the sole ownership of a single country. That country, if it wishes, can control the amount of fishing effort through various techniques. Such controls could be used to increase the earnings per fisherman by reducing the number of fishermen. The fact that earnings per fisherman in a fully utilized fishery can be increased over the long term only by reducing or limiting the number of fishermen constitutes the essential dilemma facing fishery administrators.

In many situations, policy-makers attempt to increase earnings per fisherman without limiting entry into the fisheries. They may do this by providing price supports or other devices that increase the revenue per unit of fishing effort, thereby raising the total revenue curve as shown in Diagram 2. In the short term, subsidies produce additional profits for the fishermen, attract more fishermen into the fishery and raise total costs until they reach total revenues again. Average earnings per fisherman decline to their former level but more

difficulties, the government financing system will assume their liabilities. The amount of liability taken over by the government has been substantial in recent years due to the severe economic status of the fisheries industry".

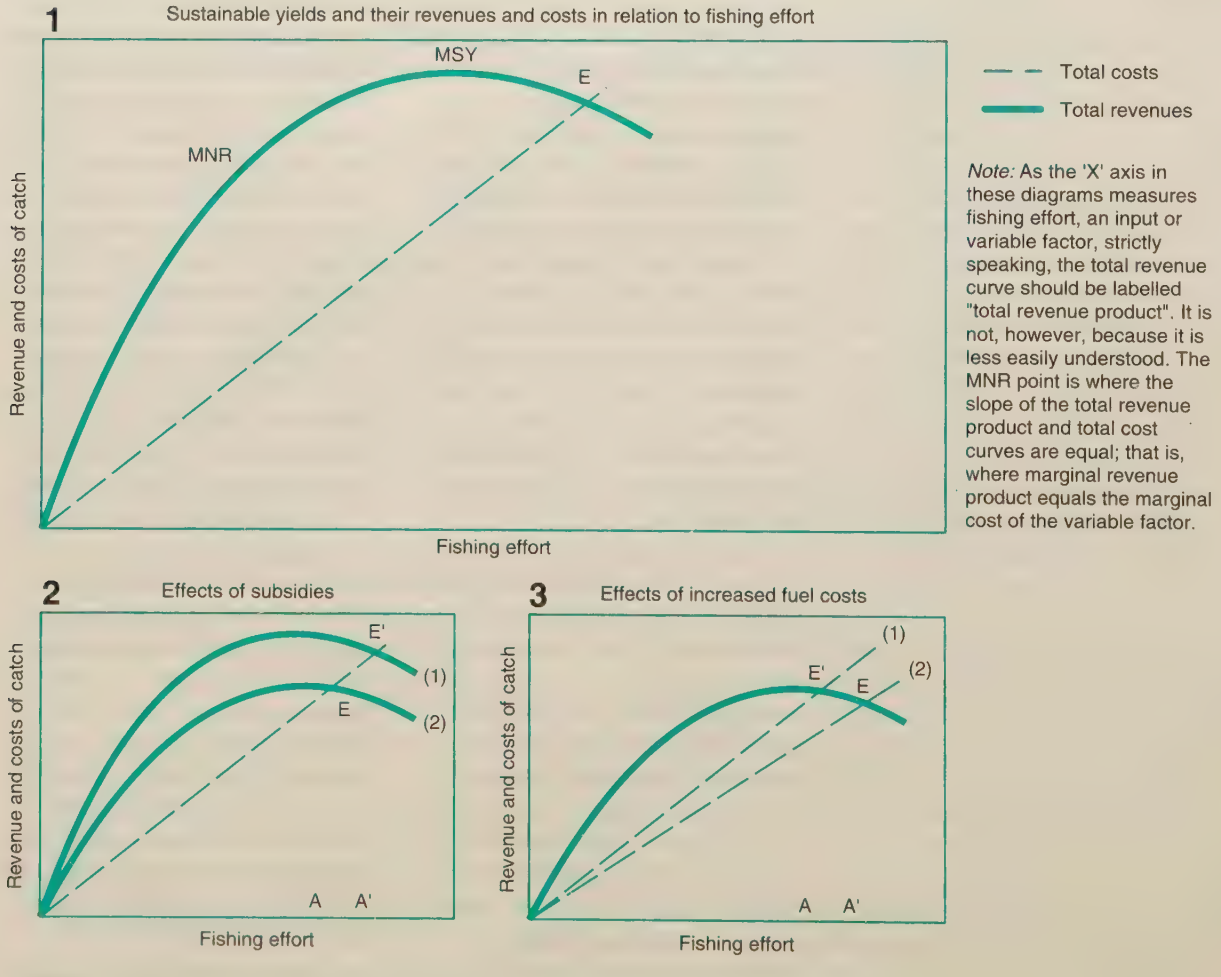
European Community fisheries also receive substantial support. Between 1983 and 1990, EEC support rose from US$ 80 million to US$ 580 million, about 20 percent of which was for the construction of new vessels and modernization of old ones (Fig. 26). This amount does not include substantial subsidies provided by the national governments. Elsewhere in Europe, Norway also provides significant fisheries support, which amounted to about US$ 150 million per year during the second half of the 1980s.[10]

[10] P. Salz. 1991. *The European Atlantic fisheries: structure, economic performance and policy.* The Hague, Agricultural Economics Research Institute.

fishermen are employed (at point A' instead of point A). In some cases, the subsidy may also lead to greater depletion of the stock. It can be noted that a rise in prices through increased demand also has the same result. Over a 30-year period in the Alaskan salmon fishery, rising prices made it economically feasible for twice as many fishermen to be employed catching half as many fish.

An increase in fuel costs clearly has a negative effect on fisheries but the result, after a period of adjustment, tends to be a drop in employment in the fishery rather than a decrease in average earnings.

REVENUES AND COSTS IN A COMMON PROPERTY FISHERY



Note: As the 'X' axis in these diagrams measures fishing effort, an input or variable factor, strictly speaking, the total revenue curve should be labelled "total revenue product". It is not, however, because it is less easily understood. The MNR point is where the slope of the total revenue product and total cost curves are equal; that is, where marginal revenue product equals the marginal cost of the variable factor.

Source: The State of Food and Agriculture 1980

Fisheries are directly or indirectly subsidized in a variety of ways. Traditional kinds of subsidy are: import restrictions and tariffs (including limits on landings of foreign vessels); export support; price control systems; fuel subsidies; and low-cost loans or outright grants for the construction of vessels or the purchase of gear; the construction of ports, marketing facilities and other infrastructure.

In addition, there are fishery-specific subsidies such as the payments made by governments to coastal states for access to their zones and the waiving of payments by domestic fishermen for access to their national zones. Free access to a natural resource constitutes a subsidy to the users since no payments are being made for the resource. Under a system of controlled access, economic rents are captured by the government through taxes or licence fees.

The reasons for granting such subsidies are as

The increase in costs forces some of the fishermen out of the fishery but, as they leave, those remaining increase their average catches and revenues because of reduced competition. The new equilibrium (point E' in Diagram 3) comes with fewer fishermen (at A' instead of A) receiving the same average net earnings as they did before. If the stock is depleted, the higher fuel costs could actually lead to higher total catches by removing some of the excessive fishing pressure.

Thus, countries' attempts to protect their fishermen in fully utilized fisheries by subsidizing fuel often serve to maintain employment levels and preserve the excess capacity already in the fishery as well as supporting high levels of fuel consumption. The introduction of fuel-saving devices and techniques may have the same consequences. Cost reductions and increased profits attract more fishermen and thus increase the use of fuel. Where fisheries are already fully utilized, the most effective technique for reducing fuel consumption is through a reduction in the number of fishing vessels.

In other cases, the cost may be so high (or the prices so low) that the equilibrium point occurs before the point of MSY. Although total levels of catch could increase, a reduction in fishing effort would still be desirable in order to achieve increased net revenues from the fishery.

The diagrams represent typical stylized fisheries but not, of course, all fisheries. In some cases, a fishery may be just developing so that there are opportunities to increase total catches and total revenues at greater rates than those of the increases in total effort and total cost. Many such opportunities are occurring where coastal states can replace foreign fishing effort by developing their own domestic capacity. But even in these cases, the growth in domestic fishing effort should be promoted with restraint so that excess capacity is avoided.

These economic principles have been tested in numerous empirical studies. One example is the yellowtail flounder fishery in the United States where it was found that the net revenue to the fleet could increase from zero to more than US$ 6 million per year by removing 87 to 132 fishing vessels.[1] However, these principles are based on simplified assumptions that do not accommodate the high degree of complexity existing in most fisheries. Fishermen generally take several different species of fish, either simultaneously or at different periods during a season. The species may be interrelated so that the yields of all may not be maximized at the same time. Yields may also fluctuate widely and, in some cases, may grow or decline in response to shifts in environmental conditions. In addition, economic factors may vary widely over time as well as among fishermen using different techniques and gear for the same stock. However, although these various elements may obscure or change the timing and significance of the consequences, they do not prevent them from occurring where the condition of open access is left uncontrolled.

Where a coastal state has complete control over a fully utilized stock of value to foreigners but has no interest in developing its own fishing capacity, it can prevent excess effort by levying taxes on foreign fishermen. These taxes deter some foreigners from fishing but those who pay receive greater catches because of the reduced competition.

Where the coastal state has exclusive control over the resource and a fully developed capacity to harvest the stocks, it may have to choose between the alternative objectives of maximizing employment opportunities or maximizing incomes.

[1] J.M. Gates and V.J. Norton. 1974. *The benefits of fisheries regulation. A case study of the New England yellowtail flounder fishery.* Marine Technical Report No. 21. Kingston, University of Rhode Island, USA. 35 pp.

manifold as the types of support schemes. In many cases, financial help is given to the fishing sector — and less frequently to the post-harvest sector — for social reasons; for example, to sustain employment in sometimes sparsely inhabited coastal districts. Subsidies might also be given for general policy reasons, since the competing agricultural sector enjoys similar support on a large scale. In other cases, particularly in the former centralized economies in Eastern Europe, food policies were designed to ensure an adequate supply of fish to the population and fish was calculated to be cheaper than other animal protein if produced domestically. Even larger, vertically integrated corporate enterprises, whether privately or state-owned, have often accepted losses in the fishing sector because such losses were compensated by profits in processing and marketing operations.

The amounts of these subsidies (or dissipated economic rents) are not reflected in the above calculations on global costs and revenues. That they are extraordinarily large is indicated in the discussion below with regard to the cephalopod fishery off Morocco and the groundfish fishery off New England.

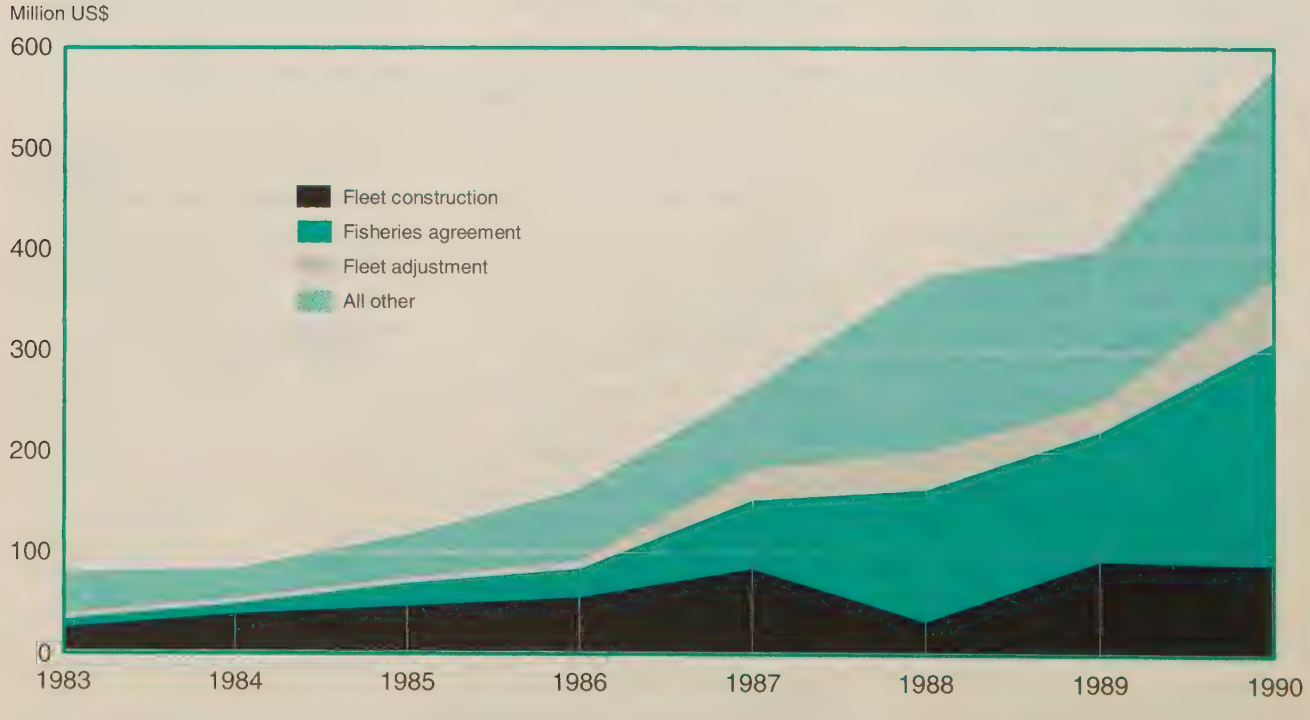
Such massive recourse to subsidies arises from governments' efforts to preserve employment opportunities in the ship building as well as the fishing industries and may be a response to the general economic plight of fisheries. However, as the opportunities for an increased catch from fishery resources have declined considerably, a continuation of the high subsidies can only lead to greater and greater economic distress as well as a further depletion of stocks. There is also the assumption that significant quantities of fish are not reported to governments, either as a result of infrastructure weaknesses in the administration of fisheries — with vessels underreporting their catches in order to circumvent management measures — or as a result of "on the grounds cash sales".[11]

Prices

Trends in the real prices of fish are critically important for evaluating the significance of economic scarcity of the resources. However, price information on fisheries remains difficult to acquire and, as a result, there are very few

[11] The underreporting of actual catches, if the quantities are significantly large, would also mean that the sustainability of the stocks being fished may be threatened.

EEC SUPPORT FOR FISHERIES



Source: P. Salz. 1991. *The European Atlantic fisheries: structure, economic performance and policy.* The Hague, Agricultural Economics Research Institute

consistent, long-term documents on the movement of fish prices. Estimates of prices received by fishermen have been derived for a few countries (Fig. 27). For these, the real prices of fish generally rose very rapidly during the 1970s: by 80 percent for the United States and Canada and by 60 percent for the United Kingdom. Significant drops occurred in the early 1980s, primarily as a result of large increases in catches and sharp declines in prices of cod and haddock during that period. Real prices of all fish species increased again in these countries
in the latter part of the 1980s. Overall, the long-term trend is upward. From the base year of 1971, real prices in 1988 were 20 percent higher in Japan, 35 percent higher in the United Kingdom and 75 percent higher in the United States.

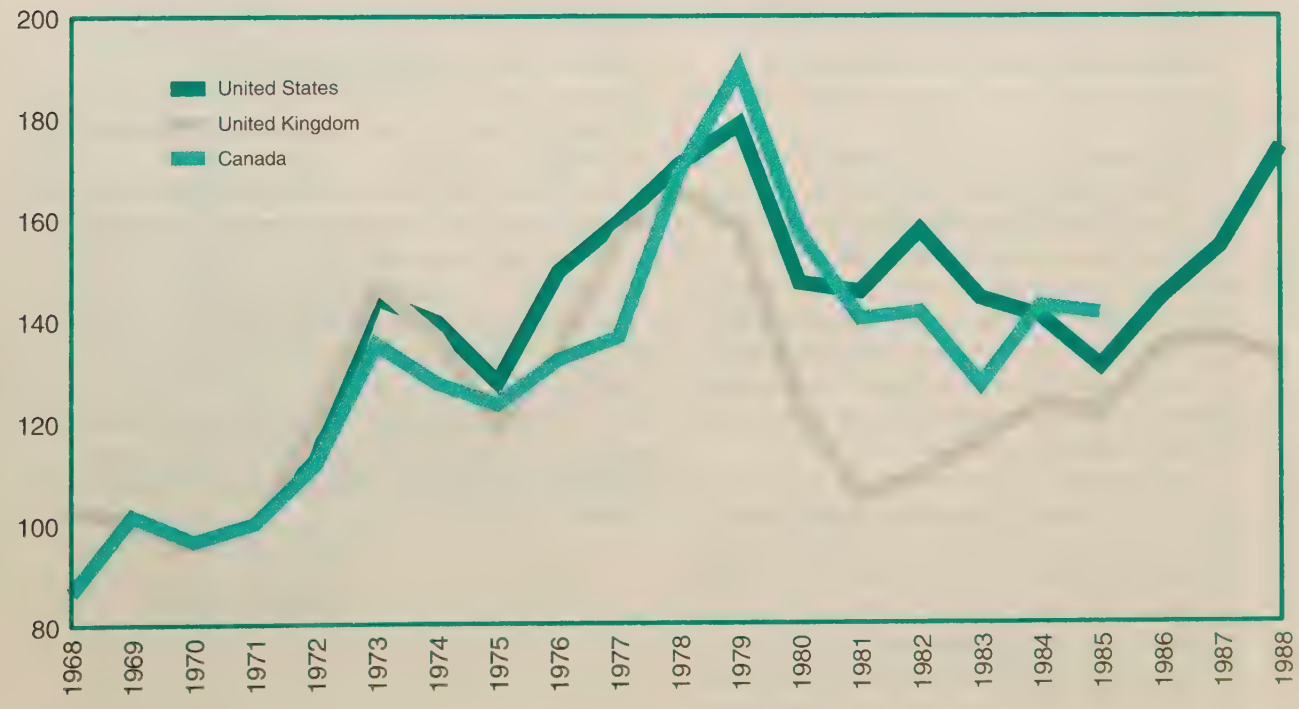
Similar documentation is not readily available for other countries. However, the information that is available on prices of individual fish species generally indicates that they are rising more rapidly than prices of other food and non-food products as well as the costs of fishing inputs. This is to be expected in view of the supply limits of wild fish stocks and the continued increase in demand. Typically, as the yield from a particular species of fish reaches its maximum, prices increase. This induces consumers to substitute other, lesser-known and lower-priced species which, in turn, become fished at their maximum levels. Prices continue to increase until reaching levels commensurate with other substitutable products.

To a large extent, the rapid increase in real fish prices in the 1970s and previous years reflected the fact that fish prices were extremely low relative to prices for other sources of animal protein. However, the gap in relative prices is closing and continued increases, particularly for some of the higher-valued fish species, may be restrained. For example, increases in the prices of tuna are constrained because of competition in the market place with chicken meat.

Other developments are also affecting the movement of fish prices. As noted above, the culture of certain species is producing sufficiently large quantities to affect the markets. In the case of salmon, real prices fell by more than 50 percent between 1988 and 1990 in the United States market. The drop in 1991 was even greater, although it was in response to an abundance of supply from wild stocks. Shrimp prices are also falling as a result of large amounts of cultivation.

REAL PRICES RECEIVED BY FISHERIES IN SELECTED COUNTRIES

(Index: 1971 = 100)



Source: FAO

Several other species are currently being cultivated (e.g. carp and catfish in inland waters; oysters, clams, mussels and other shellfish) while still more are likely to be cultivated in the future. However, the total quantities from aquaculture are still small compared with the global demand for fish.

A different kind of development is the processing of low-valued fish into products that substitute for high-valued ones. Restructured protein, largely from Alaska pollack, is being formed into products that resemble crab meat.

TABLE 23

Annual changes in value of trade in fisheries, developed and developing countries

Country group	1971-80 average		1981-90 average	
	Exports	Imports	Exports	Imports
	(.....%.....)			
Developed countries	**17.0**	**17.2**	**8.3**	**10.2**
Developing countries	**21.0**	**20.5**	**10.5**	**8.4**

Source: FAO.

International trade

Trade in fisheries has been characterized by buoyancy during the past decades, particularly during the 1970s. The value of world trade expanded at an annual rate of about 18 percent during the 1970s and nearly 10 percent during the 1980s. The expansion in exports by developing countries exceeded that of developed countries throughout the past two decades. On the other hand, the slow-down in import growth during the 1980s was significantly more pronounced for developing countries (Table 23).

The developed countries have accounted for a very high and constant share of total world imports during the past decades (88 percent of the total value in 1970 and 86 percent in 1989). There have, however, been some major shifts among developed countries. Japan's share of the value of total imports rose from 8 to 28 percent, reflecting the decline in its own catch of food fish. The most significant relative drop occurred in the United States (from 25 to 16 percent), reflecting gains through the extension of jurisdiction and its increased catch on the west coast. While the United States remains a major importer, the EEC is the largest importing region, although its imports include intra-EEC trade.

In the case of Japan, half of the imports in 1989 came from four groups of high-valued species: shrimp, tuna, squid and salmon. In the United States, shrimp make up the largest proportion of imports (29 percent in 1989). In addition, 20 percent is from frozen fish fillets and more than 10 percent from tuna. Between 1980 and 1989, there was a decline of 35 percent in imports of frozen tuna and a fivefold increase in imports of canned tuna, marking a major shift away from domestic processing, largely to processing in Thailand.

Significant shifts in market share have also occurred on the side of exports. Thailand contributed about 6 percent to the total value of exports in 1989, compared with less than 1 percent in 1970. Shares by the Republic of Korea and Taiwan, Province of China, also rose significantly from negligible amounts in 1970 to 5 percent each in 1989. Other changes among exporting countries are the declines in contributions from Peru, Norway and Japan and the increase in that of the United States.

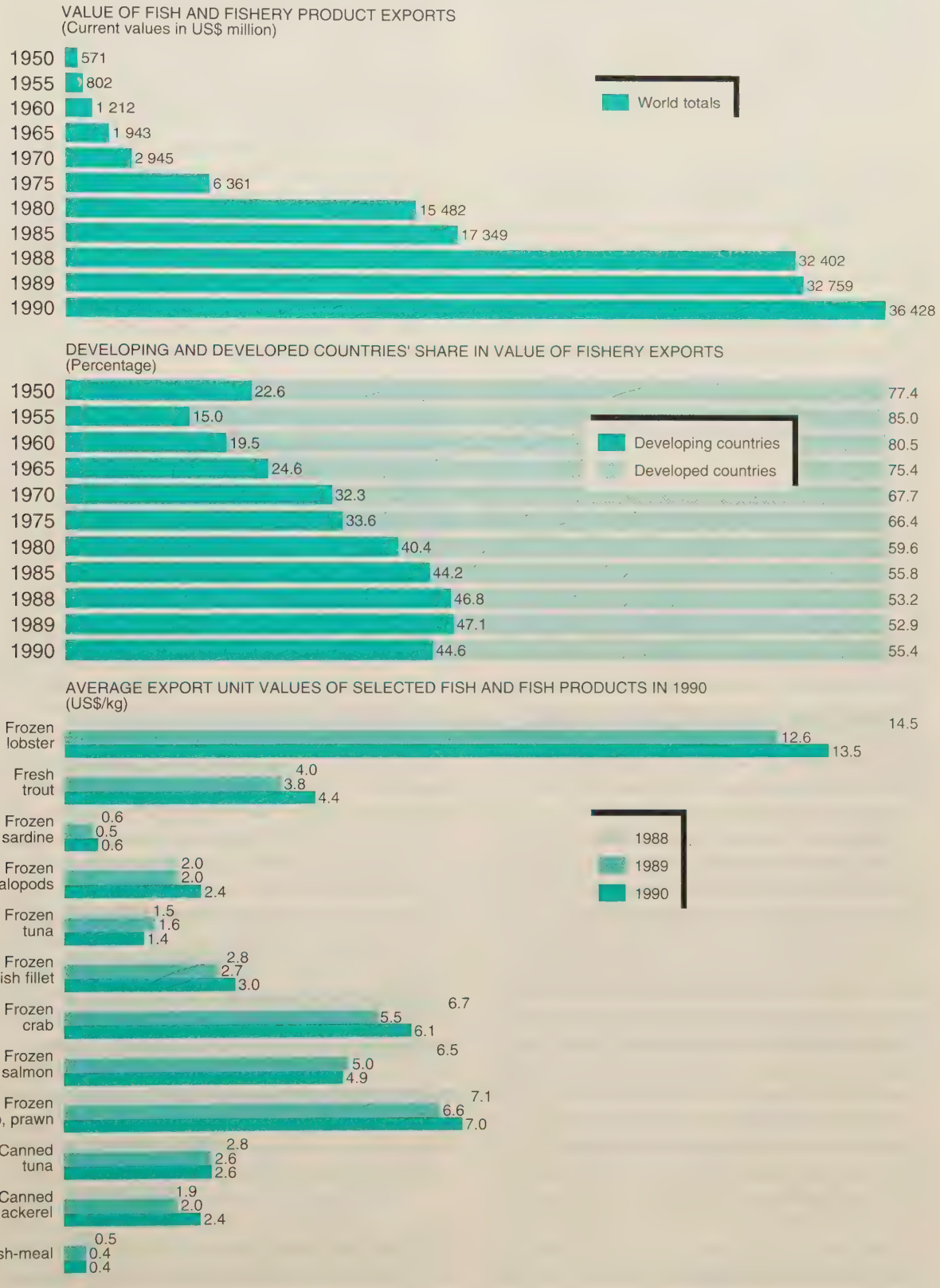
The increase by the United States was almost entirely the result of acquiring jurisdiction over Alaska pollack resources as well as the development of joint venture operations under which United States flag vessels sold their catch over the side to foreign processing vessels. These sales, counted as exports, rose from 400 000 tonnes in 1983 to almost 1.5 million tonnes in 1987 before dropping to less than 400 000 tonnes in 1990 as domestic processing took over.

Overall, the developing countries increased their share of exports between 1970 and 1989 from 32 to 47 percent of the total, with major relative increases by China, Chile and Thailand (Fig. 28). Thailand's exports rose from 2 to 13 percent of the total value of developing countries' exports, partly because of a dramatic increase in its exports of canned tuna, which rose from 5 000 tonnes in 1981 to more than 225 000 tonnes in 1989. Most of this increase resulted from the processing of imported frozen tuna. Thailand also increased exports of frozen shrimp, mostly produced by culture, by almost four times over the same period. At the same time, Thailand's exports of fish-meal declined by more than two-thirds as they were diverted to use in domestic shrimp culture.

China dramatically increased its exports of frozen shrimp, from 22 000 tonnes in 1985 to 120 000 tonnes in 1989, which accounted for over half the total value of its fish exports in the latter year.

For Chile, the increase came mostly in the export of fish-meal. Although the Peruvian share of developing countries' exports fell from 35 percent in 1970 to 3 percent in 1989 (a result of the collapse of the anchoveta fishery), together with Chile, Peru accounted for about two-thirds of the total quantity of fish-meal exports in 1989.

WORLD FISHERY EXPORTS BY VALUE FOR DEVELOPING AND DEVELOPED COUNTRIES



Source: FAO

LEGAL, INSTITUTIONAL AND ENVIRONMENTAL DEVELOPMENTS

In addition to the developments taking place in fishing activities and marketing, there have been several other developments of significance for the sector. These include changes in the law of the sea, in international arrangements for fisheries and in the marine environment.

The law of the sea

After more than a decade of discussions, the UN Convention on the Law of the Sea was opened for signature at the end of 1982. When it was closed for signature at the end of 1984, 159 states had signed it. Among the few members of the United Nations that did not sign the convention are the United States, the United Kingdom and the former Federal Republic of Germany. As of 31 March 1992, 51 states had ratified the convention, nine short of the 60 required for the convention to enter into force. Although the convention has not yet come into force, many of the provisions relating to fisheries have been adopted unilaterally and can be said to be part of customary international law.

Most important is the extension of national jurisdiction, as mentioned earlier. This occurred during the 1970s through claims to EEZs or to Exclusive Fishing Zones. These claims are generally to 200 nautical miles from shore but, in many cases, are more narrowly limited because of the proximity of adjacent states. The great majority of these claims were made in 1977 and 1978, when more than 60 states announced their claims.

The generalized extension of jurisdiction has had several effects. Most important has been the provision to coastal states of the authority necessary for effective management of their resources. Even though, at present, only a relatively few states (Australia, New Zealand and Namibia) have used that authority to exercise controls over access to the resources by domestic fishermen, there is an opportunity to do so that did not really exist under the era of freedom of the seas.

A second effect has been the redistribution of the seas' wealth in fisheries. This effect, however, has been of major importance for only about a dozen states.

International arrangements

Adjustments in multilateral arrangements for the management of fisheries have also occurred as a result of jurisdiction extension. During the period of narrow limits of jurisdiction, many regional fishery bodies were created for various purposes, including the acquisition of data; coordination of research; sharing of information; and recommendation of conservation and management measures[12]. In most cases, the bodies included both coastal states and non-coastal states with an interest in the region. They were generally successful, at least initially, in improving the collection of data on catches and in sharing information. They provided a general forum for the discussion of issues but were never particularly effective in resolving problems. With a few exceptions, they had only limited success in preventing the depletion of stocks and no success in preventing economically excessive fishing efforts.

During the 1970s, as jurisdiction was extended, some regional fishery bodies were abolished. Others changed their functions and methods of operation and new bodies emerged to replace old ones. In general, the FAO bodies continue to operate, although with severely diminished funding in most regions. These bodies attempt to provide fora for the exchange of information and guidance for technical assistance projects.

Non-FAO bodies that have been abolished as a consequence of extended national jurisdiction include the International Commission for the Northwest Atlantic Fisheries (ICNAF) and the International Commission for the Southeast Atlantic Fisheries (ICSEAF). New bodies which have arisen either to replace those abolished or to deal with new situations include the Northwest Atlantic Fisheries Organization (NAFO) and the North Atlantic Salmon Conservation Organization (NASCO).

Since 1980, other international bodies have been created, including the South Pacific Forum Fisheries Agency (FFA). This body is instructive in several ways. Its superior body, the South Pacific Forum, was created by the South Pacific Islands in order to provide a regional organization with membership restricted to countries of the region, unlike the South Pacific Commission whose members include non-local states. The South Pacific Forum created the FFA to facilitate fisheries management, particularly

[12] Conservation is defined as actions required to ensure the sustainability of the resources being exploited; management refers to the allocation of the resources.

the management of tuna species that migrate through the extensive EEZs of its members and to provide support to its members in the implementation of management measures.

The FFA has operated relatively effectively in coordinating the negotiations of its member states with the foreign countries whose vessels wish to gain access to the region and also in establishing minimum terms and conditions. In addition, FFA member states, through licencing arrangements have agreed to limit purse seine fishing effort. This management initiative will principally benefit high cost fishing countries (Japan and USA) and will alleviate conservation concerns. It has also established a regional register for fishing vessels. Through these measures, the agency has been able to increase the revenues extracted from foreign fishermen and reduce the costs of surveillance. It is noteworthy that a recent agreement between the Pacific Islands and the United States stipulated that the payment of fees by the United States should cover the total area of the agreement, including high sea areas. Certain special circumstances have facilitated the work of the FFA. The EEZs of FFA member states cover a large proportion of a vast region and the major tuna fisheries fall within these EEZs. The members are mostly small states with only a limited capacity for tuna fishing and consequently have much to gain by coordinating their management and controls over foreign fishermen. Although the FFA conditions do not exist to the same degree elsewhere, some of these approaches are being adopted elsewhere. Some Caribbean countries have already established a register, eastern tropical Pacific countries are currently considering the idea of a regional register for foreign vessels, and a pilot register is being established in northwest Africa.

Generally, the trend over the past two decades has been to increase the strength of coastal states within regional arrangements and to decrease the role of the non-regional states, although attempts to stem this trend are still being made by distant-water fishing countries. Beyond this, it is difficult to discern any generalized developments, largely because of the disparities among the different regions' situations. There is, however, a general question being raised that may have significant implications for future regional fishery bodies; that is, the degree to which they will acquire authority to govern the use of resources beyond the 200-mile limit. This issue is being raised not only with regard to the high sea enclaves in the South Pacific but also with regard to the "doughnut hole" in the Bering Sea, the Grand Banks in the northwest Atlantic; and the use of driftnets on high sea areas in the Pacific. For most of the Pacific international mechanisms for the management of high seas fisheries do not yet exist. For the management of high seas tuna fisheries, ICCAT (International Commission for the Conservation of Atlantic Tunas) exists for the Atlantic, and the IATTC (Inter-American Tropical Tuna Commission) exists for the eastern Pacific. A proposed convention for the establishment of the Indian Ocean Tuna Commission (IOTC) is under discussion. Tunas in other high seas areas are not covered by international bodies.

Environment

By far the most significant environmental change related to fisheries is that resulting from the overfishing of stocks. It was estimated more than 20 years ago that an additional 20 million tonnes of catch could be achieved by rehabilitating overfished stocks. Although there are a few instances where rehabilitation has occurred, such gains have been more than counterbalanced by the increased depletion of other stocks.

With limited supplies and rising demand, there is an increase in the pressure on fish stocks. Where there are no controls over access to the stocks, individual fishermen have the incentive to intercept stocks at earlier stages in their life cycles which generally occur close to shore and when fish are smaller. Furthermore, the gear used in this competitive race is generally less selective and takes greater quantities of by-catch.

It has been shown above that the 1989 marine catch of 85 million tonnes had a gross value at the fisherman's level of about US$ 70 00 million dollars. If management measures are implemented to allow stock rehabilitation, the 20 million tonnes of increased catch that could eventually occur would add more than US$ 16 000 million to the gross revenue, *ceteris paribus*. This estimated foregone loss, however, is only a portion of the economic waste in global fisheries, since total world catch could be taken with considerably lower amounts

of fishing effort and considerably lower total costs.

Depletion of stocks occurs not only because of the overfishing of target stocks but also because of the large by-catches of other species. With a few minor exceptions (e.g. harpoons) all types of fishing gear take other species in addition to those intended. The amounts and kinds of by-catch vary with the kinds of gear. Bottom trawls (particularly for shrimp but also for groundfish in general in coastal areas) are perhaps the most in need of improvement for environmental reasons. In the tropical waters of developing countries, the shrimp taken in trawls may be only 10 to 20 percent of the total haul, with the rest made up of other aquatic species. Most of this is trash fish which may be thrown overboard or sold for fish-meal, for processing into fish paste or as feed for aquacultural operations. Some is sold to low-income consumers. Much of this by-catch is made up of juveniles of species which could be sold at high prices as adults.

Increased intensity in shrimp trawling in the past two decades has led to increases in the proportion of by-catch. Although real prices of shrimp have probably declined in the past two or three years because of increased production from aquaculture, this has not necessarily led to a decreased intensity in trawling, since there has been a rise in demand for trash fish for use as feed in aquaculture. In fact, in some countries, shrimp farmers are now investing in trawls with small mesh nets to target trash fish. This is considered a form of "biomass fishing".

Another development in recent years has been the move to areas far from land. Certain species have been fished in the high seas for many years, including tuna, salmon and squid. In the last decade, however, some distant-water fleets, facing declining stocks and increasing difficulties and costs in gaining access to EEZs, have increased their efforts in areas beyond 200 miles from shore. Squid and tuna remain major targets but high sea fishing for pollack and horse mackerel is also taking place. The amounts and associated by-catches are sufficient to raise issues concerning the management of these high sea resources.

Another pervasive and damaging change in the marine environment has been the increasingly severe degradation of the coastal zone. It has been estimated that two-thirds of marine fish production comes from stocks which pass the first and most vulnerable stages of their life cycles in coastal areas.

Coastal zone damage is particularly acute in developing tropical countries where both natural and economic conditions contribute to the high vulnerability of these areas. In these countries, the growth in population and migration to coastal cities and regions are leading to increases in municipal and industrial discharges and landfill, mangrove clearing, coral mining and other construction-related damages. In some countries, siltation is becoming severe as a result of deforestation, the construction of lumber roads and land clearing. Intensified agriculture is contributing increasing amounts of pesticides and herbicides to coastal waters.

Intensive forms of aquaculture are themselves a source of pollution. The release of excess feeds and faeces in semi-enclosed environments has already generated eutrophication problems and oxygen deficiencies which are directly detrimental to farming enterprises. In shrimp farming, the clearing of mangroves, the extensive harvesting of wild larvae and the indiscriminate use of antibiotics to control diseases are negatively affecting other important commercial marine fish stocks.

In addition, certain fishing practices are having severe environmental effects. Such practices include the use of dynamite and poisons as well as techniques in which fish are driven into nets by swimmers pounding the coral reefs with rocks, for example the *muro ami* fishing in the Philippines. Local populations resort to these highly destructive techniques when faced by increasingly scarce resources and a lack of alternative opportunities for employment.

In the past two decades, the degradation of the marine environment has increased significantly, mainly through exacerbated overfishing and coastal zone pollution. The trend is highly disturbing, since fish are one of the major sources of animal protein and are of critical importance to the increasing populations in developing countries.

MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

III. Current and future issues

The developments of the past decade have significant implications for the future management of fisheries and raise issues with regard to achieving increased benefits from existing resources. Many of the major challenges of the past decade will continue into the future, requiring significantly increased attention in order to prevent continued waste and conflict. Other developments are still emerging and are likely to lead to changes in various elements of fisheries, with positive outcomes in some cases and possibly negative ones in others.

THE FUNDAMENTAL PROBLEM OF OPEN ACCESS

The single most important issue that must be resolved to deal with the current massive waste in fisheries is controlling open access. The extension of jurisdiction was a necessary, but insufficient, step in this process. Today, open access continues to exist within the common property zones of most coastal states as well as on the high seas.

The consequences of maintaining open access are extraordinarily damaging. As has been pointed out, they include the depletion of marine stocks, the dissipation of economic rents and increased conflict among users.

Conflict often occurs because of the lack of valuation of the resources. In the absence of exclusive use rights, the same stock of fish or same area of the sea can be used by different types of users. Users may be high sea fishermen from different countries, or fishermen from different villages, fishing in coastal waters; fishermen using different kinds of gear, such as trawlers and stationary gillnets or traps; they may be people with different values, such as commercial or recreational interests and fishing or mammal protection interests; or they may be groups using the environment for different purposes, such as waste disposal, coral mining and landfill. Conflicts between the different interest groups are becoming increasingly pervasive and severe.

Several studies of the amounts of rent being dissipated have been carried out on fisheries within national zones. "These estimates show that extraordinarily large economic returns are currently being wasted because of the open access condition, on the order of thousands of millions of dollars annually in resource-rich areas."[13] The losses of US$ 250 million per year in the Moroccan cephalopod fishery have already been mentioned. In the United States, the National Marine Fisheries Service has estimated that the current gross revenue from New England groundfish is about US$ 170 million. With proper management controlling capital investment in the fishery, the gross revenue could be US$ 200 million and the net revenue, which is currently dissipated, could be about US$ 130 million per year, or 65 percent of the gross revenue.

A summary of economic analyses of the amounts of potential or actual rents in Australian fisheries showed that the rents ranged from 11 to 60 percent of the gross revenues, with a weighted average of 30 percent.[14]

Some speculation can be made about the global economic waste in fisheries, based on the rough estimates of present costs and revenues and economic rents that might be produced under efficient fisheries management. As discussed in the section, Fishing costs and

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[13] J.-P. Troadec and F.T. Christy, Jr. 1990. Temporarily out of stock: *a diagnosis and a strategy for international cooperation on fishery research.*

[14] D. Campbell and J. Haynes. 1990. *Resource rent in fisheries.* Canberra, Australian Bureau of Agricultural and Resource Economics.

revenues (p. 17), the current total costs in fisheries are estimated to amount to about US$ 124 000 million per year, producing a gross revenue in the order of US$ 70 000 million per year. Subsidies are presumed to cover most of this deficit. Estimates suggest that proper management of depleted stocks could increase global marine catch by about 20 million tonnes. With stock rehabilitation, gross revenues could rise to US$ 85 000 million at current prices. If the ratio of gross revenues to rents in the Australian fisheries is applied, it would mean that the annual resource rents for global fisheries would be about US$ 25 000 million per year. Removal of the subsidies of US$ 54 000 million per year would produce US$ 79 000 million in annual global net economic revenues, all of which are currently wasted. This estimate (minus the costs of management) represents the potential global economic benefits that could be derived from the removal of subsidies and the achievement of effective fisheries management.

It should be reiterated that these are rough estimates and are only intended to provide orders of magnitude. It should also be pointed out that nothing has been said about the costs of achieving these rents. These costs include the direct costs of administration, research and enforcement as well as the transaction costs of achieving the necessary adjustments in capital and labour and negotiating agreements among competitive users.

Despite their shortcomings, these estimates clearly indicate that the costs of present mismanagement in fisheries are extremely high. There is an urgent need to address the problems associated with free and open access and review alternative systems of property rights, including exclusive use rights, as are now being applied in a few countries such as Australia and New Zealand, as well as the Japanese community–based management system. It is equally urgent to begin placing appropriate values on the resources as a means for facilitating the resolution of conflicts. These interrelated steps are discussed more fully in the section on fisheries management.

SUPPLY AND DEMAND

Resource effects

One of the particularly important characteristics of fisheries is that supplies of most wild stocks are naturally limited. Although the population of any individual stock may fluctuate in response to natural environmental changes at any time, there is a maximum yield that can be harvested on a sustained basis. Increased fishing effort beyond that point does not increase total catch and may, in fact, lead to lower annual yields. Demand for fish products, however, continues to increase as human populations expand and income levels change. The inexorable consequence is a general rise in the real prices of fish, as has been shown. To the extent that fisheries are unmanaged, the rise in prices may even cause a contraction in supply. This would occur if increasing prices were to push fishing effort beyond the point corresponding to the MSY, reducing future fish stocks even further with increased fishing effort.

On the other hand, when fish stocks are effectively managed through systems of property rights, the higher real prices increase the value of the resource itself, with benefits accruing either to the fishermen or to the management agency. In some cases, introducing more effective management leads to increased supplies and hence reduced prices.

Most major fisheries in the world have experienced significant losses in yields due to the depletion of the stocks. The rise in real prices increases the benefits of such measures but, simultaneously, increases the difficulty of their implementing them because of the incentive it provides to invest in excessive fishing efforts.

Supply increases

Aquacultural markets. Although supplies of fish are limited in general, there are certain opportunities for reducing or removing the constraints. For some species, cultivation is possible through various systems. These range from extensive systems under which the sole intervention is the planting of seeds (as in oyster farming) to highly intensive systems which require interventions in reproduction, nutrition, the gene pool and disease and environmental elements (e.g. shrimp, catfish and carp in ponds and salmon in cages).

Cultivated products can be divided into four main groups. Some production is aimed at the high-income market, primarily, although not

exclusively, in developed countries. This currently includes salmon and shrimp but there is potential for other species such as sea bass, groupers and some marine flatfish. A significant part of total aquaculture production, in quantitative terms, is made up of molluscs, including clams and oysters (which have been farmed since the days of the Roman Empire), largely consumed in high-priced markets; and cockles and mussels, which are lower priced and consumed in developing as well as developed countries. The largest group includes freshwater finfish, mostly various species of carp which are grown in small farm ponds in developing countries. By far the greatest amount is produced in China whose total aquacultural production is estimated to account for 48 percent of the global production of all aquacultural products. The fourth major group includes seaweeds and other aquatic plants.

The total estimated annual production from aquaculture (from both fresh and marine waters) is currently more than 14 million tonnes. This figure, however, is somewhat misleading with regard to supplies of food for human consumption. The estimate for molluscs includes the weight of the shell which is about four times the weight of the meat. Seaweeds and other aquatic plants make relatively small contributions to human consumption. In addition, the production of shrimp and marine finfish uses relatively large amounts of other fish as feed. With regard to freshwater finfish, its contribution to food supplies is very large in Asia and significant in Europe and North America, but of only negligible importance in Africa. It is currently of small but growing importance in Latin America.

The increase in production of shrimp and salmon has been very rapid, leading to adjustments in the market which may restrain growth in the short term. There are also some indirect effects and production problems that need to be solved: for example, disease associated with intensive culture; pollution from excess feeding; obtaining regular supplies of high-quality feed and seed; and the maintenance of genetic diversity.

For shrimp, some of these problems are having major negative effects in several developing countries. Fairly large areas of mangrove swamps have been cleared for shrimp farms. The demand for seed has led to the intensive harvest of planktonic materials (although an increasing amount of seed is now being raised in hatcheries). The demand for feed is leading to biomass fishing. These developments tend to reduce the potential supply of fish that can be used as food for domestic consumption in developing countries, particularly for the low-income consumers. These issues are forcing many developing countries to rethink their policies aimed at expanding shrimp farming.

Overall, the rise in real prices stimulates further increases in aquaculture production. The greatest contribution to future supplies is likely to come from increases in freshwater finfish culture and, to a lesser extent, from the culture of molluscs. In Asia, this will require increased efficiency in present culture practices. In Africa, efforts to develop fish farming have been less successful than anticipated. Improvements will require new approaches that take account of the indigenous social and economic constraints.

Development of new stocks. Demand for fish is generally limited to a few hundred thousand species of marine organisms. There are certain characteristics that are important in affecting taste preferences: size, boniness, oiliness, flesh firmness, taste and colour. There are also important supply characteristics, such as ease of capture, ease of processing and perishability. Most of the thousands of species not consumed or used by humans at present are likely to remain unused, similar to weeds in agriculture. Changes in taste preferences and demand do, however, take place and there are some possibilities for increasing total supplies by the development of stocks of unconventional species and by technological innovations permitting the capture of stocks that are inaccessible to conventional gear.

Within the past two decades, a number of stocks have been brought into production, including: Chilean jack mackerel in the high seas of the South Pacific; several stocks of oceanic squid; orange roughy from seamounts off New Zealand (currently overfished); and Antarctic krill (to a limited extent). These developments have occurred because of changes in taste preferences and technological innovations, such as large driftnets, which make it economically feasible to harvest low-density stocks.

The physical potential for development of unconventional stocks is very large, particularly from squid, Antarctic krill and mesopelagic species. Although squid, in certain regions, offer some opportunity for further economic development, it is unlikely that significant quantities of catch will be taken from krill and

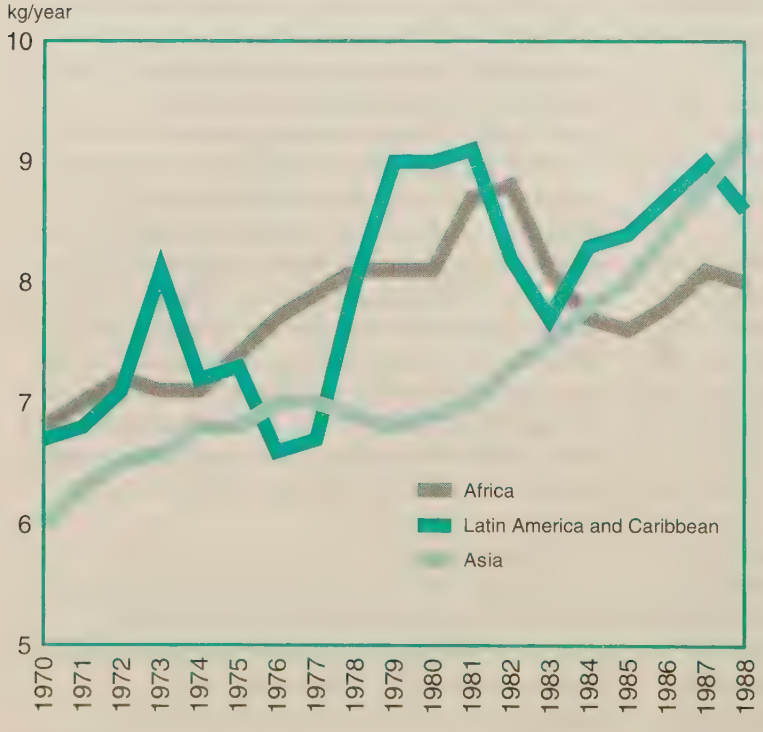
BOX 14

The role of fish in food supply and nutrition

The use of fish as a source of food has increased steadily, rising from 40 million tonnes in 1970 to 70 million tonnes in 1989. Supplies for developing countries have risen more rapidly, at 4 percent per year, than those for developed states, at 1.6 percent per year.[1] Quantities available to developing countries, 36.2 million tonnes, exceed those for developed countries, which stand at 33.7 million tonnes. There are, however, considerable regional differences among developing countries. In 1989, supplies to Asian countries reached 26.4 million tonnes, more than five times those to African (4.6 million tonnes) and Latin American (3.7 million tonnes) countries. On a per caput basis, the developed countries have average supplies of 27 kg per year, as against an average of 9 kg for all developing countries. Fish as a source of food is critically important for developing countries where a large portion of the population receives most of its animal protein from fish. It is, therefore, disturbing to note some recent changes in fish supplies. Although per caput supplies rose in Asia by 33 percent between 1980 and 1988 (largely because of the burgeoning production in China), they fell by 1 percent in Africa and by 4 percent in Latin America and the Caribbean (see Fig. A).

[1] Supplies are estimated on the basis of the production of fish for food purposes from all sources (freshwater as well as marine), plus imports minus exports, and adjusted for changes in inventories.

PER CAPUT FISH FOOD SUPPLIES IN DEVELOPING REGIONS



Source: FAO

A source of high-quality protein

Fish plays a vital role in feeding the world's population, contributing significantly to the dietary protein intake of hundreds of millions of people. On a global scale, almost 16 percent of the total average intake of animal protein was attributable to fish in 1988. Recent global statistics reveal wide variations in fish consumption, but people in developing countries are generally much more dependent on fish as a part of their daily diets than people living in the developed world. Only in a few developed countries, most notably Japan, does the population derive more than 20 percent of its total "meat" supplies from fish.

A source of high-quality protein, fish supplies 29 percent of the total animal protein in the diet of Asian populations; the contribution to the diet of Africans is also important, about 19 percent. In Latin America, intake of fish as the main source of animal protein is sharply lower at about 8 percent (Fig. B).

Programmes to develop domestic consumption, increase aquacultural development and improve the diets of the rural poor are encouraging

consumption of more nutritious, low-cost fish products in this region.

While overall world consumption is on the increase, fish plays a less central role in the diets of developed countries. In North America, it contributes only 6.6 percent of the total animal protein intake; in Europe and the USSR, intake is almost double at 12 percent. Demand is expected to increase in the developed countries over the next decade as the nutritive and health values of fish — especially its role in lowering blood cholesterol levels and as a low-fat and low-calorie food — are more widely promoted.

CONTRIBUTION OF FISH TO DIET, 1987-89
(Regions and selected countries)

Source: FAO

mesopelagic stocks for many years to come. Furthermore, in view of the fact that these are important sources of feed for other, more valuable resources, it would probably not be desirable to harvest them in great quantities, without prior assessment of the impact of harvesting these species on the potential of other species.

Reduction in post-harvest losses. A large amount of fish protein is lost after it is caught and before it reaches the consumer. With increases in fish prices and more effective price structures, some of these losses may be reduced.

There are several kinds of losses associated with fish harvesting. The large amount of by-catch wasted in shrimp fisheries exists in most other fisheries as well. In addition, the limited capacity for storing fish in both small and large vessels is a source of waste. When fishermen catch more valued species or larger sizes of fish late in the trip, they tend to keep these and dispose of their earlier catch by throwing it overboard. In some cases, certain management practices lead to waste. For example, if there is a limit to the by-catch of certain species, fishermen may dispose of their excess by-catch by throwing it overboard so that they can continue fishing. In the case of the United States Pacific halibut fishery, where the season lasts only one day, fishermen lay out an excessive number of long lines in order to be sure of maximizing their catch. At the end of the day, any lines not hauled will be left in the water and will continue to hook fish, including halibut. Improved management practices are essential. Their achievement would be greatly facilitated by an improved valuation of the resources and by price structures that fully reflect the differences in values of different resources.

The high degree of perishability of fish leads to further post-harvest losses both on-board and in processing and distribution activities. It is estimated that up to 10 percent of total food fish supplies are lost because of insufficient care in handling, insufficient chilling, pest infestation, poor processing and spoilage. The existing technology is generally sufficient to deal with these problems but the costs are high. The increase in real prices and growth in demand for higher-quality products provide a significant incentive to reduce these kinds of losses.

Supply shifts

Certain developments are also leading to shifts in supply of fishery products and may eventually produce increases in total supply. These include the development of substitute products and the possible shift in the use of certain species from fish-meal to food for humans.

Development of substitutes. The demand for certain products can be met, in part, by the conversion of raw fish protein material into products with similar characteristics. As noted, the process of fish flesh extraction, known as surimi, is currently being used to produce substitutes for crab meat from Alaska pollack and is partly responsible for the doubling of catches of that species over the past two decades. For high-income consumers in developed countries, these techniques reduce the importance of species characteristics and allow adjustments in demand and supply by converting low-priced species to high-priced products.

In many developing and some developed countries, it is traditional to convert trash fish and waste products into fish paste or fish sauces used as food additives. This process does not, however, offer much opportunity for expansion. If trash fish is increasingly diverted to fish feed for aquaculture, there may be a loss of such forms of protein for human consumption.

Shift from non-food to food uses. Currently, about 30 percent of the total world catch of fish is used to produce fish-meal, oil and other industrial products. Most of this catch comes from large-scale catches of small pelagic species for which there is little demand as food at present. There have been many past attempts to develop processes for converting this raw material into products for human consumption. Although the technology for doing so is available, the costs are still too high to attract investment, as demand still appears limited.

The effect of generalized fish price increases on such possible shifts in consumption is unclear. One difficulty is that the major market for low-priced fish is Asia, whereas the major sources of the small pelagics are off Latin America and Africa. Another factor is that the growth in aquaculture is creating an increased demand for high-quality fish-meal. Nevertheless, it is possible that the small pelagic species may eventually provide an important supply of fish food for human consumption.

Effects of demand

As a general pattern, taste preferences for fish are continually undergoing change. To begin

with, there is low preference for unconventional species which may be sold at low prices to low-income consumers. But as the prices for the more preferred species rise, middle-income consumers turn to the species consumed by the poor. This causes a shift in the demand curve and an increase in price, eventually removing the species from the tables of the poor who must then turn to other unconventional species. The writer, Charles Dickens, through the character of Sam Weller, noted in the nineteenth century that "poverty and oysters always seems to go together", a remark that would scarcely obtain today.

This pattern, however, is being broken at both ends of the consumer scale. At the lower end of the scale, particularly for the low-income consumers in Asian countries, the pattern is being broken because they are running out of unconventional resources to develop in the near shore waters. This is being exacerbated by biomass fishing, the intensive harvest of seed for aquaculture and the degradation of the coastal zone. The high and growing demand in developed countries is also leading to a diversion of resources towards those markets and away from the low-income consumers, who are the most seriously deprived by the rise in fish prices.

At the upper end of the scale, the pattern is being broken because some fish products are being "priced out of the market". Prices of fish, in general, have tended to be lower than prices of other animal proteins. While this is still true for most fish products, there are some whose prices have reached a point where those of competitive non-fish products are about equal, as in the case of canned tuna and chicken meat in the United States market. When this occurs, the upward movement of fish prices is constrained.

HIGH SEAS FISHING

One of the consequences of rising real prices, together with the problems of gaining access to EEZs, has been increased fishing activity on the high seas. This activity has resulted in three types of problem. One is where pelagic stocks migrate both within and beyond 200 miles from shore. The second occurs at the edges of continental shelves, where some stocks of groundfish can be found straddling the 200-mile limit. A third, not strictly pertinent to the high seas, except in a legal sense, occurs where high seas exist just beyond narrow limits of jurisdiction.

High sea pelagic fishing

In the high sea areas away from continental shelves or coastal upwellings, the density of most stocks is generally very low. For the efficient harvest of these stocks, it is either necessary to filter great quantities of water with the use of exceptionally large driftnets or longlines or to make use of natural or artificial aggregation devices (setting purse seine nets on schools of dolphins or on logs which occur naturally or which have been placed in the sea). Such high sea fishing has produced two kinds of reaction: concern about the possible depletion of stocks and concern shown by states about the marine mammals and birds that are taken as a by-catch of the drift gillnets and longlines.

High sea fishing of salmon by Japanese vessels in the North Pacific has long been a concern to the United States, and led to the signing of the North Pacific Fisheries Convention in 1952. Under this convention, Japan agreed to abstain from high sea salmon fishing because the stocks were being managed and were fully utilized by the coastal states (the United States and Canada). More recently (in 1989), apprehensions about the by-catch of salmon in the North Pacific high sea driftnet fisheries for squid resulted in observer programmes for the operating fleets. Bilateral agreements, stipulated between the United States and Japan and between Taiwan, Province of China, and the Republic of Korea, could eventually lead to the adoption of regulations on the use of such nets.

In the South Pacific in November 1989, the developing island states as well as New Zealand and Australia opened for signature a Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific[15]. Under the convention, member states prohibit their vessels

[15] As of August 1992, fifteen South Pacific countries had signed the Convention, while USA, Canada and Chile have signed one or the other of the two protocols under the Convention. Seven countries have ratified the Convention or its protocols.

from using long driftnets (in excess of 2.5 km in length), both on the high seas and within their EEZs in the South Pacific, as well as prohibiting the use of driftnets by all vessels within their zones. They also agreed not to allow the provision of services or assistance to driftnet vessels operating in the high seas or to vessels engaged in supplying the driftnetters.

Considerable attention by certain countries (particularly the United States) has recently been devoted to the issue of by-catches by these types of gear since the catch tends to include marine mammals and birds. In December 1989, the UN General Assembly (UNGA) adopted Resolution 44/225, recommending that all nations agree to moratoria on all large-scale driftnet fishing on the high seas by 30 June 1992 unless "effective conservation and management measures be taken based on statistically sound analysis...to prevent unacceptable impacts of such fishing practices in that region and to ensure the conservation of the living marine resources".

In support of this resolution, in October 1991 the United States adopted a ban on the imports of fish caught with large driftnets (more than 2.5 km in length) on the high seas. It listed as the high sea driftnetting nations: France, Japan, Taiwan, Province of China, the Republic of Korea and the Democratic People's Republic of Korea.

The UNGA resolution contains a principle which, if widely adopted, would significantly affect the realization of benefits from fishery and all other natural resources. "The Resolution actually reverses the normal burden of proof to require that conservation measures be in place *before* the available scientific data support specific action and before fishing may begin or be continued."[16] This "precautionary principle" would virtually prevent the exploitation of any new natural resources in international areas since it would be difficult to determine impacts prior to their actual development. In addition, the impacts may not be so much the consequences of the technique that is used, but more the result of an excessive use of the technique. Any acceptable fishing gear can have damaging impacts on both target and by-catch species when it is used to excess, an issue which is not addressed by the resolution.

The other type of high sea fishing depends on the location of stocks aggregated in sufficiently dense schools to permit economically efficient harvesting. This approach is used for tuna fishing by pole-and-line and purse seine operations (although the former is decreasing in the South Pacific because of high labour costs). The major cost element in these types of fishing is the time required to search for the schools, but this has been improved greatly over the decade with the introduction of remote sensing and long-term forecasting.

In the eastern tropical Pacific, certain types of tuna (particularly large yellowfin, averaging 25 kg) are found in association with porpoises. It is economically efficient for purse seiners to set their nets around these schools but it does lead to some porpoise mortality, although techniques are available for reducing the rate of mortality. In the same area, schools are also associated with drifting logs but, here, the tuna tend to be smaller -- less than 5 kg in size.

The by-catch of porpoises in tuna purse seine nets is not a recent development, having been a concern throughout the past two decades. Initially, the large number of porpoises taken in the eastern Pacific (700 000 to 850 000 individuals in 1961) raised the serious issue as to the ability of certain species to survive. Controls adopted by the United States led to a reduction in the number of porpoise kill to about 90 000 to 110 000 individuals in 1987 and an estimated 25 000 in 1990. Overall, the problem of porpoise kill has been significantly mitigated by IATTC's implementation of a combination of gear modifications and fishing manœuvres. Purse seines have been modified with the addition of Medina panels and Superaprons so that, in the final phase of pursing, the porpoises could be spilled out of the net in a "backdown manœuvre" which leaves the deeper-swimming tuna in the net.

Government-imposed reductions in the incidental catch of porpoises ensure that efforts continue to reduce the kill further by improving fishing methods and by sensitizing fishermen to environmental issues.

Attempts to achieve zero mortality, however, are likely to have negative effects in two regards. First, if the goal is achieved it is likely that the yield of yellowfin tuna in the eastern Pacific would be significantly reduced, since the fishery would have to restrict itself largely to the small yellowfin tuna in free schools or those associated with floating logs. It has been estimated that this would lead to a decline in catches to one-third or one-half of present

[16] FAO. 1991. *Law of the sea concerning coastal state authority over driftnets on the high seas.* Legislative Study No. 47. Rome, FAO. (italics in original)

levels.[17] Second, controls established unilaterally by the United States may not be effective in preventing other countries from taking porpoises and cause purse seines to shift operations to the Western Pacific. At present, some major United States tuna canners are refusing to buy tuna caught in association with schools of porpoises. This sanction may now be having an effect on production by other states.

In ocean regions other than the eastern tropical Pacific, the association of large tuna with porpoise schools is less strong; in the western Pacific other means are used for locating the stocks. The development of remote sensing techniques is proceeding rapidly and may soon lead to the ability to predict precise locations of tuna schools. This technique could considerably reduce search time and costs. It could also, however, lead to the congestion of vessels on the schools and to overfishing. These various developments indicate a strong and urgent need for international arrangements concerning the management of tuna fisheries.

Extended continental shelves and straddling stocks

There is also an urgent need for improved international arrangements to deal with the management of the demersal stocks that straddle the boundaries between the high seas and national limits of jurisdiction. These areas occur where continental shelves and slopes extend beyond 200 nautical miles from shore: notably the "doughnut hole" in the Bering Sea between Russia and the United States; the Grand Banks in the northwest Atlantic and the Patagonian shelf off Argentina.

The "doughnut hole" is an area situated more than 200 miles from both the United States and the Russian Federation and in which sizeable stocks of Alaska pollack are found. These fish have attracted a considerable fishing effort by other states and led to an increase in catches of pollack to an estimated 1.3 million tonnes in 1987.[18] It is not entirely clear whether these stocks are completely independent of those found within the national zones (as claimed by the distant-water fishing states) or are stocks that straddle the national zones (as claimed by the coastal states). If the latter is the case, then fishing within the "doughnut hole" can affect the status of the stocks within national zones and vice versa.

In the northwest Atlantic, there has been a growing conflict between the coastal State and distant water fleets with regard to the management of the cod stocks that are found on the outer edges of the Grand Banks. This conflict has been a major issue for the regional international management body, the Northwest Atlantic Fisheries Organization (NAFO) and was recently temporarily resolved when the fishery was closed, due to the decline of the resources.

An additional problem facing NAFO, as well as other international management bodies, is that of new entrants. Under the NAFO arrangement, total allowable catches are set for individual stocks and these are then divided up into shares for the member states. According to the convention that established the organization, no state can be prohibited from joining NAFO.[19] When additional states exercise their right to join, the pie must be divided into smaller slices, thus decreasing the shares of the original members.

These problems question the desirability of the conventional approach, followed by most international management bodies, of determining total allowable catches and dividing them into individual national quotas.

In addition to the North Pacific and northwest Atlantic, similar conflicts are emerging between the coastal state and distant-water countries fishing on the Patagonian continental shelf and slope.

There is an increasing trend of fishing vessels evading management regimes by the re-flagging of their vessels to flags of States which are not members of an international fishery commission. This means that they can continue fishing in the area beyond the EEZ without having to comply with the regulations set by the international body for its members. If fishing by these vessels on the high seas areas significantly affects the yields from the stocks as a whole, the benefits of the conservation measures are dissipated and the viability of the arrangement is threatened. Furthermore, catches by these vessels are not reported.

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[17] *Summary Minutes of the 48th Meeting of the Inter-American Tropical Tuna Commission*, San José, Costa Rica, 17-20 September 1990.

[18] E.L. Miles and W.T. Burke. 1989. Pressures on the United Nations Convention on the Law of the Sea of 1982 arising from new fisheries conflicts: the problem of straddling stocks. *Ocean Dev. Int. Law*, 20(4): 343-357.

[19] Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries, 24 October 1978.

High sea areas beyond narrow limits of jurisdiction

There are still some areas into which jurisdiction has not been extended or where claims have not yet been put into effect. These areas include the Mediterranean Sea, the South China Sea and the Antarctic Ocean. In the first area, fishery conflicts are largely, although not entirely, bilateral issues of concern to adjacent or opposing states. A regional body, the General Fisheries Council for the Mediterranean (GFCM), provides a forum for the exchange of information and adoption of recommendations on management measures. In the South China Sea, claims to extended jurisdiction involve significant disputes over the ownership of two sets of islands in the middle of the Sea: the Paracel Islands to the north and the Spratly Islands to the south. At present, fishing in the areas of dispute is not of major consequence. The main issue of contention is rather the presence of potential mineral resources.

In the Antarctic region, several international treaties relate to the use of fishery resources. These include the Antarctic Treaty (1959), the Convention for the Conservation of Antarctic Seals (1972) and the Convention for the Conservation of Antarctic Marine Living Resources (1980). Discussion on Antarctic issues now take place within UNGA. Since 1983, no change has been accepted.[20]

The international regime of the high seas

The issues raised by these developments on the high seas were not fully addressed by the 1982 UN Convention on the Law of the Sea. With regard to the high seas, the convention urges cooperation among the fishing states: "States shall co-operate with each other in the conservation and management of living resources in the areas of the high seas. States whose nationals exploit identical living resources, or different living resources in the same area, shall enter into negotiations with a view to taking the measures necessary for the conservation of the living resources concerned. They shall, as appropriate, co-operate to establish subregional or regional fisheries organizations to this end."[21]

For straddling and highly migratory stocks, the convention states that coastal and fishing states should seek to reach agreements on the management of stocks either directly or through subregional and regional organizations.

Although not in force, the view has been expressed in a number of international fora that the 1982 Convention provisions dealing with fisheries contain relevant legal principles applicable to the conduct of high seas fishing. However, it remains unclear precisely how the rights and obligations of States are to be met; the precise scientific bases for management decisions, the kinds of institutions that may be used or created, the rights of third parties, and even the goals of management.

In this situation, pressures are emerging to take steps based on immediate or special interests that may have significant long-term or broader consequences. The adoption of the "precautionary principle" is but one example. There are also pressures to extend unilaterally national authority beyond the limits of the EEZs. In the United States, west coast fishermen are pressing for the extension of national jurisdiction, either unilaterally or jointly with the Russian Federation, to cover the high sea enclave in the Bering Sea. Strong pressures are also emerging in eastern Canada to deal with the problems in NAFO.

Although a number of regional fishing bodies do not have a good record in resolving conflicts and achieving effective fisheries management, some cases indicate that improvements are possible. The first (and, in some regards, the most efficient) international fisheries agreement was created in 1911 by the Convention for the Preservation and Protection of Fur Seals. It was signed by Russia, Japan, the United States and the United Kingdom (acting on behalf of Canada). The stimulus for the agreement was the decline in the stocks of North Pacific fur seals due to overharvesting. The agreement stipulated that all harvesting of the fur seals at sea would be prohibited and that harvesting could only take place on the breeding islands. By doing so, the costs of harvests were diminished to a small proportion of the costs incurred when harvesting took place at sea, while the quality of the furs (and prices) increased. The parties to the agreement, who relinquished their right to high sea sealing, received a share of the skins by way of compensation. When the agreement was renewed in the 1950s, Japan and Canada each received 15 percent of the skins harvested by the United States and the USSR on the

[20] FAO. 1987. Le système des Nations Unies et le régime de l'Antarctique. *Le Droit et la Mer*, p. 233-266. Rome, FAO.
[21] *United Nations Convention on the Law of the Sea*, art. 118. UN Document No. A/CONF. 62/122.

islands under their jurisdiction.[22] The fur seal convention was terminated in 1984.

The South Pacific Forum Fisheries Agency (FFA), whose members include the small Pacific Island States, Australia and New Zealand, has been an effective fishery body, achieving greater benefits from access arrangements than could have been achieved by individual negotiation. Costs of enforcement have been significantly reduced through the creation of a Regional Register of Foreign Fishing Vessels, and measures implemented to reduce fishing effort principally for conservation and management purposes.

In a multilateral agreement with the USA, the Pacific Island States are to receive US$ 60 million during a five-year period for fishing rights, and under a ten-year extension of the Treaty a significantly higher amount will be paid. The Pacific Island States have separately agreed among themselves to share the proceeds so that 85% of the revenues are allocated on the basis of the location of USA catches and 15% is to be distributed equally among all parties. This allows those States without significant tuna resources to receive some of the benefits for their participation in the agreement.

This compensatory mechanism helps to ensure stability in the regime. The success of the arrangement depends on the states being able to maintain a united front with regard to distant-water fishing vessels and, in order to achieve this unity, the states that have rich resources are willing to compensate the less well-endowed states with a share of the resource rents received.

Both the principles and the models of the North Pacific Fur Seal Commission and the FFA have much to be recommended for the achievement of effective management and the resolution of conflicts over high seas and nationally controlled resources, even though the conditions that facilitated the success of these arrangements are not generally found in other ocean regions. The basic principle is the treatment of fishery resources as resources that have value *in situ*; a value definable in monetary terms. The model is that of an international regime that achieves stability by the sharing of the benefits deriving from use of the resources and providing compensation for those members who are less well endowed.

The management of straddling and high sea stocks is basically no different from the management of stocks lying fully within national zones, except for the kinds of participants and the distribution of benefits. A first step would be to move from management based on physical quantities to management based on economic values. This step would necessitate the adoption of measures designed to maximize the net economic revenues that can be produced by the resources. Such measures would be based on transferable use rights which might be vessel licences, individual shares of total allowable catch or total revenues, or individual shares of total allowable investment. The choice would depend upon the characteristics of the fisheries, including the costs of enforcement.

A second step would be to provide the means for extracting the economic rents. This could be done by the auction of use rights or the imposition of taxes or user fees. For the purpose of achieving stability in the regime, it would be essential that the maximum rents be extracted from the entire managed resources, whether they fall within or outside economic zones. When preferences are given to coastal states in the form of lower payments, the coastal states tend to attract excessive effort, leading to the dissipation of rents and a reduction in revenues available for other parties. The bona fide interests of the coastal states in the resources can be met through the distribution process.

The establishment of a system for distributing the benefits would constitute the third step. The benefits would be in the form of the economic rents, net of the costs of achieving them. The costs would be those of the management body for administration, research and enforcement. These costs are likely to be relatively small so there should be substantial surplus revenues available for distribution.

Distribution should be done in such a way that the stability of the regime is assured; that is, that all parties feel they have more to gain by maintaining the regime than by proceeding on their own. Achieving stability entails allowing the most efficient producers to operate and compensating those who do not receive fishing privileges but who are in a position to affect the

[22] The agreement initially collapsed in 1941 when the Japanese withdrew, alleging that "both direct and indirect damage had been inflicted on the Japanese fishing industry by the increase of fur seals" (M. Whiteman. 1965. *Digest of International Law*, p.1 042. Washington, D.C., United States Department of State). The number of fur seals reportedly increased from 125 000 in 1911 to approximately 2 300 000 in 1941. A new agreement was reached in 1957, with the provision that the determination of the total yield should take into account the effect of fur seal predation on the productivity of other living marine resources.

outcome of the regime. Herein lies the problem, as four different types of participants can be identified. At the most restricted level, the participants sharing the benefits would include only the coastal states. Where high sea catches are inconsequential, this may be effective in maintaining stability. But where high sea catches can affect total yields, this restricted approach would not succeed.

A second set would include the present distant-water fishing states and the coastal states. This approach, currently being followed in some regions, is only effective as long as there are no new entrants from non-contracting states. However, as demonstrated, the problem of new entrants is already emerging and it may therefore be necessary to broaden the membership to include all states with a potential as well as a current interest in fishing. This presents the problem of defining states with a potential interest.

The final set would be to include all countries of the world, land-locked as well as coastal. This approach does not mean that every country need receive a share of the rents directly but that the rents might be devoted to a purpose that is generally agreed to provide benefits for the world community. It is possible to identify uses that would leave all countries with the feeling that they are better off by complying with the regime than by breaking it.

In all cases, the amounts of shares would be subject to negotiation. Clearly, a significant proportion should be allocated to the coastal states but the amount might vary according to the degree in which the managed stocks are found within their zones. The distant-water states that are currently fishing in the zone might also be accorded a significant share as a means for buying out their "historical" right of free fishing.

During the past decade, the management of high sea fisheries has appeared as a significant international problem, not fully anticipated by the UN Convention on the Law of the Sea. The general response to the problem has been to modify and adjust the past forms of international arrangements. While there is consensus to accept the provisions of UNCLOS and make every effort to find ways in which these provisions can be implemented, it is crucial that collaboration be intensified between coastal States and distant-water fishing nations to resolve the allocation issue. Without a satisfactory solution, waste and conflict will continue.

ENVIRONMENT

The interrelationships between fish stocks and their environment have always been matters of considerable importance for fisheries. In the past decade, however, several developments have occurred that have sigttention is being given to possible global climatic changes and the degradation of coastal zones.

One of the basic difficulties in examining the effects of environmental changes is that of distinguishing between natural and human causes. Global ocean currents move in complex ways which are not well understood at present and which bring with them changes in temperature, salinity and nutrient levels. Different species have different levels of tolerance to these elements, thriving or weakening according to the mix. The changes may produce either short- or long-term variations in population size.

It is well known that significant variations in stock size occurred prior to the advent of fishing operations. Cores taken from lower sediments show interrelationships among certain species, with some dominating a biological niche in certain periods and some in other periods. The influence of natural climatic change is particularly strong for shoaling pelagic species which are caught in extraordinarily large quantities; the Peruvian anchoveta and the Japanese, South American and South African pilchard, for example. In these situations, it is difficult to separate the effects of environmental degradation and intensive fishing from those of natural climatic fluctuations.

Thus, there are not only uncertainties with regard to the degree to which global warming may occur but also in terms of the effects it may have on fisheries. Certainly, if there is a large rise in sea level, the devastating effects on coastal cities and communities will make the effects on fisheries pale into insignificance. But a moderate rise in global temperatures still deserves attention. It is unlikely that total marine fish production will change very much, although changes in the composition of species that make up the catch can certainly be expected, as can changes in areas of high productivity. The highly fertile tropical upwelling zones may move closer to the poles. Changes in rainfall patterns could lead to increased erosion on formerly dry land areas, with associated increases in coastal siltation, and to decreased run-off from river basins, with associated declines in nutrients. At present,

aside from such generalized statements, little can be said other than that there is a need to increase research on global warming.

More immediately apparent are the several kinds of change taking place in coastal aquatic ecosystems. One is the increase in nutrient-rich wastes coming from municipalities and farms. In some cases, such nutrient discharges may enhance fishery production but, more generally, they may have damaging effects, such as oxygen depletion (resulting in fish larva kills) or blooms of phytoplankton species. The latter is often a cause of "red tides" and can produce paralytic shellfish poisoning (PSP).

The growing amounts of soil erosion and fresh water run-off resulting from deforestation and certain agricultural practices are leading to increased siltation and changes in water temperatures, salinity levels and transparency, with consequent damages to coral reefs and aquatic vegetation.

Chemical pollutants may enter the coastal zone: when discharged directly into water from industrial operations that are not governed by international conventions or in cases of accidents; as pesticide and herbicide run-off from farms; or as fallout from the atmosphere. Changes are also occurring through the extraction of sand and gravel and the mining of coral as well as through land reclamation activities, including the clearing of mangroves, often for the purpose of shrimp farming.

Pressures on the coastal zone ecosystem will increase in the future. It is estimated that, by the year 2000, 60 percent of the three billion people living in urban areas will be concentrated in settlements less than 50 miles from the sea, while many more will be in settlements along rivers sufficiently close to carry pollutants into the sea. Developing countries will be at a particular disadvantage in attempting to cope with the pressures because the immediate and manifest needs for food, living space and employment are likely to outweigh the less direct and visible need to avoid damage to the coastal zone. For example, dichlorodiphenyltrichloroethane (DDT) is commonly used and sometimes subsidized in developing countries even though the downstream damages are such that it has been banned in many developed countries.

It is estimated that 80 percent of marine pollution comes from land-based sources whereas the preponderance of the harm is felt by marine fisheries and aquaculture. There is therefore an asymmetry between those who cause environmental harm and those who bear the costs.

The tasks of dealing with the changes in the coastal zone are multidimensional and extremely difficult. Integrated coastal zone management involves the international, regional, national and local levels. It also involves a variety of government agencies and private enterprises. At the international level, there is considerable need for research on a range of problems. A major area for research is that of determining the nature and extent of the damages that may be occurring from changes in the coastal environment. This requires research on the effects of environmental change on stock productivity and composition; the development of models to understand coastal ecosystem dynamics; the causes of phytoplankton and algal blooms; and the development of models for the analysis of economic relationships between the multiple sources of environmental change and its effects.

In addition to research, there are international responsibilities for aiding developing coastal states in their attempts to deal with these problems. This assistance includes education and training, technical assistance and changes in development aid to ensure environmentally sound projects. In this last regard, it is essential that the preparation of projects takes into account the full value of the natural resources as well as the costs of their management. These tasks are equally critical for national governments.

One of the major reasons for the misuse of the coastal zone is the absence of a satisfactory pricing system and, as a result, the imperfect or zero valuation of the resources themselves. Access is free not only for fisheries but also for the consumption of water and the use of water as a carrier of waste. Other resources are underpriced, including forest land (priced at timber value), mangrove swamps (used for land development or aquaculture) and coral reefs (as a source of building materials). When natural resources are undervalued, there is inevitably a misallocation of the other factors of production (labour and capital) as well.

The provision of use rights and pricing systems can help to rationalize the allocation and use of the resources. Use rights and pricing systems can be achieved through a variety of means, such as access licences, pollution permits, quota shares, user fees, taxes and incentive payments. Use rights can be provided to individuals, companies or communities. The

charges for the use rights can be extracted by the government and used to protect societal interests that may not be covered by the system and to cover the costs of management. In Japan, where communities have exclusive use rights to fishing areas, those who wish to use the areas for other purposes (e.g. the construction of airports or disposal of wastes) must pay the communities for these uses.

SMALL-SCALE FISHERIES

Although the past decade did not bring any major new developments for small-scale fisheries, there was a general increase in the awareness that they had been badly neglected and that development projects had been insufficient to improve their welfare. In developing countries, interest has increased in community-based management of fisheries.

Small-scale fisheries are important sources of employment and food in many countries throughout the world, particularly in the developing countries of Africa and Asia, although there are no accurate estimates of the number of small-scale fishermen in developing countries. India, alone, is estimated to have one million active fishermen and there are well over one million in members of the ASEAN. Many more are engaged in part-time fishing and there are large numbers who are involved in marketing and other ancillary activities. Of equal importance is the fact that the sector produces a large amount of animal protein, particularly for low-income consumers.

Despite its importance, small-scale fisheries are generally characterized by low incomes and poor living conditions. Fisheries are often considered as the "employer of last resort" because of the open access property rights condition which prevails in most countries. Although social and cultural barriers to entry exist in some fishing communities, there are still many situations where fishing labour increases in spite of static or declining levels of catch. Often, the increase in fish prices makes up for the decrease in amount of catch per person and, as in other sectors, a large part of the increase in labour results from population growth within the fishing communities.

The growth in the labour force and the inability to expand the resource base have sometimes induced small-scale fishermen to engage in highly damaging fishing techniques, such as the use of dynamite and poisons for the harvest of the resources, thereby diminishing the resource base even more.

An additional cause for concern in small-scale fishing communities is the result of well-intentioned aid for improvement in vessels and gear. Fishermen, traditionally fishing from log rafts or small pirogues powered by hand or sail, sustain considerable physical hardship. Motorization reduces that hardship but it also tends to reduce employment. New forms of fishing gear can have similar effects. Since total

catches cannot be increased, there is a significant displacement of labour which presents severe problems in areas of high unemployment.

In many regions of the developing world, small-scale fishermen have experienced serious difficulties because of the intrusion of large-scale vessels into areas that they have traditionally worked. This situation has been particularly devastating in the case of shrimp trawlers, although it is also becoming important for other kinds of gear. Shrimp stocks are generally located close to shore where they can be readily taken by motorized vessels towing trawl nets over the bottom. There are several kinds of interference with the small-scale fishermen. In some cases, there is conflict over the resources, either in terms of competition for the shrimp or because of the effects of trawling on other species harvested by the small-scale fishermen. Spatial conflict occurs when the mobile trawlers move through and sometimes damage the stationary gear set by these fishermen. These conflicts have at times become sufficiently severe to result in killings and the burning and destruction of vessels.

Some countries are attempting to resolve such conflicts: in many, there are bans against trawling in inshore waters but a lack of enforcement capability generally renders these measures ineffective. In the case of Indonesia, the conflicts became so severe that *all* trawling has been banned from the western two-thirds of the country, thereby easing the task of enforcement.

More recent sources of distress for the small-scale fishermen are the damages to the environment of the coastal zone (see Box 15). Small-scale fishermen generally have limited mobility and cannot easily escape the damages to the stocks or impediments (e.g. siltation) in access to the sea.

The poverty of the small-scale fishermen, however, is only partially inherent to the sector. In many situations it may be more the consequence of a lack of satisfactory use rights than an indication of fundamental inefficiency in the enterprise. Small-scale fisheries in developing countries have certain economic and social advantages over large-scale operations: they make less use of capital, particularly imported elements; they use less fuel; they generally use more selective gear; they are based in rural areas; and they produce food for the domestic market rather than for export.

These advantages were largely neglected, if not harmed, by former development assistance programmes supporting the construction of large vessels which encroached on grounds fished by the small-scale sector. This is recognized in a number of evaluations undertaken by development agencies during the 1980s, which generally noted the high rate of failure of fishery development projects. The AsDB, the World Bank and the UNDP have all called for the redirection of support towards the small-scale sector based on an improved understanding of the social and economic characteristics of small-scale fishing communities.

A significant opportunity for improving the welfare of small-scale fishermen can be found in work of the past decade on community-based approaches to the management of common property resources. There are other natural resources besides fisheries for which exclusive use rights are imperfect, including grazing land, forest land and water supplies. There is a growing body of knowledge showing that many of these resources have been managed effectively by communities of users under traditional rules. Although many of these systems have broken down as a result of development activities and the advent of market forces, some still exist and some have been rehabilitated.

There are several advantages to these traditional systems. Local knowledge of the resources is generally superior to that of the central authorities. Local dependence on the resources is strong. The systems provide a sense of tenure security over the resources and an incentive to manage them so as to ensure the continued flow of benefits. The systems include techniques for controlling access and sharing benefits within the community — techniques that have generally been adopted as a means to preserve community stability.

These advantages have encouraged fishery administrators to explore the possibilities of supporting community approaches to management. In the Philippines, the government has transferred jurisdiction over coastal fisheries to the local municipal governments and initiated programmes to provide fishing communities with authority over adjacent resources (see Box 15). In Thailand, some communities are experimenting with artificial reefs which are intended not only as a means for aggregating fish but also to provide physical barriers to illegal trawling. In the

Solomon Islands, traditional territorial use rights systems are protected by legislation.

Territorial use rights in fisheries (TURFs) are not feasible in all situations and they face a number of difficulties in implementation. Nevertheless, together with other forms of exclusive fishing rights systems, TURFs appear to offer the greatest hope for the effective management of small-scale fisheries and improvement in the communities' welfare. For some situations, such as for migrating pelagic species, TURFs would still require deliberate allocation of stocks between users.

FISHERIES MANAGEMENT

It is abundantly clear that marine fishery resources offer an opportunity for making major contributions to the growth of national economies as well as to the world's food supply. It is also clear that these opportunities have not been realized during the past decade and that, although there are signs that the process is improving, the situation is generally worse than it was ten years ago. Economic waste has reached major proportions; there has been a general increase in resource depletion, as fishing efforts have moved down the food chain; the marine environment has become increasingly degraded; conflicts have become

BOX 15

Combating resource depletion through community participation in the Philippines

Fisheries is one of the fastest-growing sectors in the Philippines. The value of fish production grew by more than 16 percent per year during the 1980s, making the Philippines the twelfth largest fish producer in the world and the fifth largest for aquaculture. With more than 7 000 islands, the country's marine area is approximately seven times larger than its land area. Marine waters cover 220 million ha, including its 200-mile EEZ and more than 18 million ha of continental shelf.

By 1990, the value of Philippine fisheries production was more than US$ 2 000 million, accounting for 5 percent of GNP, 5 percent of foreign exchange earnings and around 25 percent of total agricultural export value. Fish products provide half the annual animal protein available to Filipinos. Over one million people, 80 percent of whom live below the poverty line, are employed in the sector. In addition, nearly 100 000 Filipinos are employed in ship building and repairs, equipment manufacturing, net rope making, ice plants and cold storage, processing, sales and distribution.

Unfortunately, population pressure and the dramatic growth in fishing effort are depleting and damaging marine and coastal resources. Illegal fishing activities, including dynamiting, poisoning and fishing with fine-meshed nets, are destroying coral reefs and fish populations. Unsound agricultural practices, watershed mismanagement, illegal logging, mangrove destruction and domestic, industrial and solid waste pollutants are rapidly degrading inland and coastal fish habitats.

The Philippine Government reports that 70 percent of the 27 000 km² of coral reef resources have been subjected to major damage — coral reef fisheries account for 20 percent of capture fish production. Estimates suggest that there are less than 25 percent of the original mangrove forests remaining (mangroves are vital to marine ecosystems).

The case of Panguil Bay

In an attempt to combat problems resulting from environmental degradation, resource depletion, low productivity and poverty, the Philippine Government, supported by the AsDB and the Overseas Cooperation Fund of Japan, established the Fisheries Sector Programme (FSP) in October 1989. The FSP has identified 12 priority bays to improve coastal resource management (CRM) and address the

more widespread; and the plight of the small-scale fishermen has intensified.

The effective management of fisheries is essential. It requires a fundamental institutional change, entailing the creation of forms of use rights to the resources. Exclusive use rights are a basic ingredient of effective management. Wherever the open access condition is maintained, the result will be economic waste, depletion and conflict.

Effective management also requires a shift in the treatment of fishery resources away from physical quantities considered as free goods towards economic resources with a specific value. This shift will occur when exclusive use rights are in place, so it is important to establish the concept of resource valuation as soon as possible. The absence of fishery resource valuations is a primary source of misallocation among different fisheries and different uses. Where the resources are valueless and there is conflict between different uses (for example, between those who fish the predator species and those who fish the prey), there is no market mechanism for determining the most appropriate mix of uses.

This is also true in situations where commercial and non-commercial uses are in conflict, such as those between tuna purse seiners and people who wish to prevent porpoise mortality. A market for the resources would facilitate the resolution of conflicts on the

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social, economic and environmental problems facing the fisheries sector. Panguil Bay, in Mindanao in the southern Philippines, is one of the three pilot bays where work began in 1990.

The Panguil Bay area is approximately 18 500 ha, with a coastline spanning 116 km and a coastal population of 450 000 inhabitants. The bay is the source of some of the most valuable species of shrimp and crustaceans in the Philippines. About 47 rivers and tributaries flow into the bay. Mangrove destruction and overfishing have contributed heavily to the decline of this copious resource base during the past decade. Less than one-third of the mangrove forests remain and recent studies report that, while fishing boats in the bay doubled between 1985 and 1991, the total catch dropped by 75 percent. By 1991, the average catch had fallen to 1.8 kg per day per fisherman, or the equivalent of US$ 2.50 per day.

Panguil Bay's CRM component is addressing these problems through site-specific planning and implementation with the combined participation of local governments, NGOs and fishing associations. Project officials maintain that success of the CRM depends on local community involvement. For example, the decentralization, training and involvement of local law enforcement is credited with an impressive record in 1990: local forces confiscated or destroyed about 1 600 filter nets, apprehended more than 60 violators, seized 30 scissor nets and uprooted more than 200 net posts in Panguil Bay.

In addition to communities enforcing regulations aimed at protecting their resources, local fishing associations are constructing, protecting and managing artificial reef sites in the mouth of the bay to replace coral reefs destroyed by dynamite fishing. Some municipalities and communities are developing territorial use rights in fisheries, delineating zones for specific fishing gears and establishing areas for seaweed, mussel and oyster cultivation.

Coastal inhabitants are reforesting 600 ha of open mud-flats through community-based contracts. Individual families are receiving certificates of stewardship to increase land tenure security and use rights to both these reforested mangrove forests and existing forests.

At the same time, mangrove zoning is resulting in commercial production zones, buffer zones, limited use zones and strict nature reserves to improve management of the mangrove resources.

basis of the amount the parties would be willing to pay to protect their interests. But in the absence of a market, decisions are made on an arbitrary basis, unrelated to the relative values of the different uses. There is no compensatory mechanism that would allow non-commercial users to reimburse the commercial users for relinquishing their rights to fish.

These steps constitute major changes which are difficult to make, largely because they initially involve decisions on the distribution of wealth. The creation of exclusive use rights, by definition, means that some acquire the rights while others are excluded. Where such exclusion affects employment and vested interests, political decisions become more difficult.

Nevertheless, the cost of maintaining the status quo is being increasingly understood. Increasing attention is being given to the malaise of fisheries and to the need for change. Several countries have already taken the necessary steps and implemented controls over access. Although these systems may contain imperfections, they nevertheless prove that it is possible to increase the contributions of fisheries to national economies and to reduce economic waste. As contained in the Declaration of Cancún: "[May] the next ten years be declared the decade of responsible fishing, so that by the turn of the century, the rich opportunities afforded by fishery resources will begin to be realized."[21]

It may be possible to expedite the rate of change. For the large-scale industrial fisheries where the proportion of global waste is so large (in both developed and developing countries), several policy changes may facilitate the process. The first is to remove the existing subsidies which exacerbate the waste and increase the impediments to change. The second parallel step would be to create use rights and allow the fishing effort to adapt to sustainable levels. The third step would be to allow the real prices of fish to increase, thereby improving the earnings of the fishermen so that they would have greater flexibility in adapting to the necessary management measures. Finally, national governments can begin to extract some of the rents and use them not only to help cover the costs of management but also to establish funds for the purpose of buying superfluous capital and labour and eventually achieving rationalized fisheries.

For countries with artisanal fisheries and where overfishing exists, the process may be more difficult because of the effects of the measures on employment. At the same time it would be facilitated because artisanal fishermen are generally less mobile. In these situations, the first step might be to transfer management authority to local levels and increase the participation of fishermen in management decisions. This approach might lead to the provision of territorial use rights to small-scale fishing communities, which would allow them to make their own decisions with regard to the protection of employment opportunities or the enhancement of economic rents. Another important step would be to remove the subsidies that currently support the industrial fleet and to eschew the adoption of new subsidies. Instead, such assistance should be devoted to creating alternative employment opportunities in the services sector of the fishing industry.

National governments are responsible for taking the necessary decisions. There is, however, a role for international agencies. One function would be to increase the analysis of different management systems throughout the world. The systems should be analysed with regard to the factors that facilitate, as well as those that impede, effective management. Conditions that allow management measures to be put into effect need to be identified and alternative approaches evaluated.

Developing countries face additional constraints because of shrinking national resources. Debt repayment problems, fiscal restraints, reduced development assistance and structural adjustment programmes are forcing governments to make difficult choices.

During the 1980s, many developing countries adopted structural adjustment programmes which resulted in significant shifts in economic policies and, consequently, in employment, consumption and production patterns. For fisheries, reduced public spending for production subsidies may improve resource efficiency over the long term, but spending on research administration and training has been reduced, resulting in government inability to address the sector's problems properly. In addition, governments must maintain a strong role in establishing policies to improve planning, management and development of the fisheries sector. As it stands now, with subsidies

[21] International Conference on Responsible Fishing, Cancún, Mexico, 6-8 May 1992.

in the developed countries and SAPs (Structural Adjustment Programmes) limiting government spending in the developing countries, the competition is unequal.

Information on management measures needs to be widely distributed so that experiences can be shared and individual countries can determine what might work best for them.

Training and education programmes on fisheries management need to be established or strengthened, not only for fisheries administrators but also for fishermen's groups which may be expected to take on increasing management responsibilities.

There is also a strong need for improving economic and social information on fisheries. This need requires analyses of the costs and benefits of collecting the information and the identification and formulation of cost-effective approaches. Training and education on economic and social data collection are also necessary.

Such activities are not particularly costly but they do require a shift in priorities and emphasis away from the traditional ways of doing business — which simply encouraged fishing effort — towards new approaches designed to meet the pressing challenge for effective fisheries management.

MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

IV. Appendix 1

FISHING COST METHODOLOGY

The basis for the cost estimates for the construction of larger fishing vessels (Table 24) can be considered fairly reliable, since information on new construction is available at shipyards. The prices refer to vessels of different length and it has been necessary to convert them to tonnage classes for the purpose of this exercise. Average unit values for the different tonnage classes have been derived from cost information on new construction, by size and type of vessel within each class. The resulting estimate of the replacement costs of the global fishing fleet are shown in Table 25. For the three million vessels included in the calculation, the estimated cost to replace these vessels at 1989 prices is approximately US$ 320 000 million.

In order to calculate operating costs for these vessels, the replacement value is considered to be the "best" measure. Without knowledge of the age structure of the fleet, the use of depreciation rate formulas may not be realistic and cannot be cross-referenced. The use of market value as the basis for the estimate would incur the same risk, while the insured value would cover only a percentage of the fleet. The following operating costs have therefore been derived on the basis of percentages of actual replacement values.

Tables 26 and 27 present estimates of annual operating costs for maintenance and repairs, insurance, supplies and gear, fuel and labour, based on percentage of the replacement costs calculated above, as assessed by staff of the FAO Fisheries Department, Fishing Technology Service. These costs are derived on the basis of vessels normally insured and subject to regular surveys, especially "in class" vessels [24]. The total annual costs for routine maintenance and

[24] "In class" refers to vessels that are certified by an international classification society.

TABLE 24

Cost of representative fishing vessels

Vessel type	Length	Material	Cost in 1988
	(m)		*(...US$'000...)*
Super trawler	100	Steel	80 000
Tuna seiner	65	Steel	15 000
Freezer trawler	50	Steel	11 000
Purse seiner	45	Steel	5 800
Stern trawler	35	Steel	4 200
Scottish seiner	25	Steel	2 250
Scottish seiner	23	Wood	1 900
Shrimp trawler	25	Steel	900
Shrimp trawler	23	FRP[1]	700
Gillnetter	15	FRP	600
Trawler	13	Ferrocement	350
Fast potter	10	FRP	120
Pirogue (inboard engine)	10	Wood	4

[1] Fibre-reinforced plastic.

Source: Fitzpatrick, J. Fishing technology, fisheries resources and future demand; in *Report of the World Symposium on Fishing Gear and Fishing Vessel Design*, St. John's, Newfoundland, Canada, 21-24 November 1988.

TABLE 25

Capital investment in global marine fishing fleet

Vessel tonnage class	Number of vessels	Average replacement cost	Total replacement cost
		1989	
(.....GRT.....)		*(US$'000)*	*(US$ million)*
>1 000	3 010	40 000	120 400
500-999.9	2 100	8 000	16 800
100-499.9	30 600	3 000	91 800
<100, decked	1 100 000	80	88 000
<100, undecked	2 100 000	1	2 100
TOTAL	3 235 710		319 100

Source: FAO.

TABLE 26

Annual operating costs

GRT Classes	Maintenance and repair	Insurance	Supplies and Gear	Fuel	Labour
			Percentages of Replacement Cost		
>1 000	7.50	1.625	1.5	1.46	2.2
500 - 999	9.00	2.275	4.0	4.46	7.5
100 - 499	10.50	2.275	6.0	4.16	8.0
<100 decked	11.25	3.000	11.0	6.00	9.3
<100 undecked	6.00	6.000	40.0	99.00	150.0
			Costs in US$ million		
> 1 000	9 030	1 957	1 806	1 758	2 649
500 - 999	1 512	382	672	749	1 260
100 - 499	9 639	2 088	5 508	3 819	7 344
< 100 decked	9 900	2 640	9 680	5 280	8 184
< 100 undecked	126	126	840	2 079	3 150
TOTAL	30 207	7 193	18 506	13 685	22 587

Source: FAO

repair (US$ 30 000 million) may appear to be high, but these should be viewed against insurance costs, whereby a good maintenance record is necessary to attract reasonable insurance premiums. The estimated annual total operating costs are US$ 92 000 million.

The calculation for some of the above costs can be cross-referenced. The estimated cost of US$ 7 000 million for insurance is approximately 2% of the replacement cost of the fleet. Fuel costs can also be derived and these are given in Table 27. The estimated annual fuel consumption in tons per vessel in each tonnage class is determined by multiplying columns 2, 3, 4 and 5 by 24 hours. This, multiplied by the number of vessels in each tonnage class and the price of fuel at US$ 300/t,

TABLE 27

Fuel cost estimates

GRT Classes	Days at Sea	Specific fuel consumption (gram/hour)	Total Installed bhp	Operational Constant[3]	Number of Vessels	Fuel Consumption (Tons/Year) Per Vessel	Fuel Consumption (Tons/Year) Per Vessel Class	Fuel Costs Per Ton	Fuel Costs Per Vessel Class/Year
1	2	3	4	5	6				
>1 000	250	160	3 000	0.60	3 010	1728.00	5 201 280	300[1]	1 560.4
500 - 999	250	160	2 000	0.60	2 100	1152.00	2 419 200	"	725.8
100 - 499	220	180	800	0.55	30 600	418.18	12 796 300	"	3 838.9
<100 decked	180	200	50	0.40	1 100 000	17.28	19 008 000	"	5 702.4
<100 undecked	180	200	20	0.20	2 100 000	3 .456	7 257 600	" [2]	2 177.3
TOTAL							46 682 380		14 004.8

[1] Large vessels using bunker oil would have a lower cost per ton (US$ 150 - 200)
[2] Small vessels usually pay higher costs (no duty free) for diesel (US$ 350 - 400) and those using petrol even higher costs.
[3] Estimated % of 24 hours at which the full power rating is applied.

TABLE 28

Estimated labour costs based on earnings per employee per year

Vessel tonnage class	Number of vessels	Number of crew per vessel	Total number of crew	Estimated earnings per employee	Total labour costs
(.....GRT.....)				(.....US$.....)	(US$ million)
>1 000	3 010	60	180 600	15 000	2 709
500-999.9	2 100	40	84 000	15 000	1 260
100-499.9	30 600	30	918 000	8 000	7 344
<100 decked	1 100 000	5	5 500 000	1 500	8 250
<100 undecked	2 100 000	3	6 300 000	500	3 150
TOTAL	3 235 710		12 982 600		22 713

Source: FAO.

TABLE 29

Fishing costs as a percentage of the total revenue

	Estimated Fishing Costs in Million US Dollars	Costs as a % of Landed Value (US$ 70 000 Million)
Maintenance and repairs	30 207	43 %
Supplies and gear	18 506	26 %
Insurance	7 193	10 %
Fuel	13 685	20 %
TOTAL	69 591	99 %
Labour	22 587	32 %
Capital (10% of Replacement Value)	31 900	46 %
GRAND TOTAL	124 078	
Less: Total Revenue	70 000	
DEFICIT	54 078	

Source: FAO.

provides the estimated cost, which for the fleet, amounts to US$ 14 000 million. It should be noted that the number of days at sea, the operational constant and the price of fuel are the key variables for this calculation.

In regard to labour costs, with the exception of the large corporate-owned vessels using bonus schemes, the common practice in fishing is to use the gross revenue as the basis for determining the return to capital and labour. This is done on a share basis - either on a ratio of an equal split between capital and labour, whereby the capital share pays the operational costs, or on a ratio calculated with the operational costs deducted from the gross revenue and the remainder divided on an agreed split between the boat share (capital) and the labour share. From the estimates given in Table 26, the global fleet costs, excluding labour, of maintenance, insurance, supplies and fuel are approximately US$ 69 500 million, and from Table 21 in the main text, the gross revenue to the fleet, in terms of estimated value of the global landed catch, is shown to be approximately US$ 70 000 million. This leaves a margin of approximately US$ 500 million to

cover costs of capital and labour. Under the circumstances of such a small margin, the common practice of using the gross revenue minus operating costs as the basis for determining returns to capital and labour cannot be followed for estimating labour's share.

As an alternative, total labour costs have also been derived on the basis of numbers of crew per vessel and likely earnings *per caput* (Table 28). The difference between the two methods of calculation is marginal; US$ 22 587 million in Table 26 and US$ 22 713 million in Table 28.

The annual operating deficit for the world's fleet would now stand at about US$ 22 000 million. Although this figure may appear to be exceptionally large, a cross-reference of the costs shows that the estimates are conservative. The calculation of 13 million crew members is an underestimate of the actual number, given that a significant number are not recorded.

The cost of US$ 7 000 million for insurance is approximately 2 percent of the actual replacement value of the fleet.

The fuel consumption for the fleet is estimated to be 46.7 million tonnes for a total marine catch of 85 million tonnes, which translates into a catch of 1.8 tonnes per tonne of fuel.

On the basis of the average price per tonne of fish (US$ 861), the above ratio becomes US$ 1 550 for every tonne of fuel (at US$ 300 per tonne). The estimates from alternative approaches appear to confirm that the costs and revenues are on the conservative side.

A large cost in fishing is debt servicing, which has not been included. In many cases it is this item that places the fishing vessel in financial difficulties, yet estimates of the actual cost are not available. Some debt servicing costs can be at preferentially low rates, particularly those provided through international financial institutions and bilateral assistance whereas, in most cases, debt servicing charges are set no lower than commercial rates.

With a replacement value of US$ 320 000 million, the return to capital would at the least be equal to opportunity costs which, since there are limited opportunities for converting fishing vessels to other uses, may be lower than in other maritime practices. For this exercise, they have been set at 10 percent. The resulting costs for the fleet would increase by US$ 32 000 million for a deficit of about US$ 54 000 million. An allocation of 17 percent of revenues is normally required as a minimum to cover debt servicing, depreciation and profit margins.

The total annual operating costs (excluding labour) of the global fishing fleet, US$ 69 500 million, are estimated to almost equal the gross revenue, US$ 70 000 million. The opportunity costs of fisheries capital alone is in the order of 46 percent of the gross revenue (Table 29). Labour cost estimates are 32 percent of the gross revenue. The percentage of operating costs, by category, of the total gross revenue of US$ 70 000 million are also presented.

MARINE FISHERIES AND THE LAW OF THE SEA: A DECADE OF CHANGE

V. Appendix 2
FISHERIES STATISTICS

TABLE 30

Eastern central Atlantic catch by coastal distant-water states

Year	Coastal developing states	Former USSR	Spain	Other distant-water states	All countries
	(Tonnes)				
1970	814 181	612 729	224 545	791 056	2 442 511
1971	897 373	790 440	223 381	833 554	2 744 748
1972	985 287	849 405	243 748	857 061	2 935 501
1973	1 079 282	943 367	373 263	773 278	3 169 190
1974	1 023 266	1 145 974	413 605	730 668	3 313 513
1975	1 026 651	1 165 972	382 427	768 073	3 343 123
1976	1 042 433	1 315 543	408 112	623 862	3 389 950
1977	1 079 761	1 134 433	440 288	932 632	3 587 114
1978	1 144 232	769 500	485 414	635 556	3 034 702
1979	1 117 329	526 011	370 543	542 978	2 556 861
1980	1 142 958	942 334	448 841	839 681	3 373 814
1981	1 253 953	780 597	406 735	586 503	3 027 788
1982	1 242 635	955 801	415 314	438 208	3 051 958
1983	1 401 704	935 833	386 986	331 804	3 056 327
1984	1 404 434	662 736	372 035	249 097	2 688 302
1985	1 454 896	708 120	383 362	294 157	2 840 535
1986	1 621 130	854 177	268 776	278 803	3 022 886
1987	1 578 559	1 062 954	201 413	347 213	3 190 139
1988	1 616 997	1 395 028	192 707	329 080	3 533 812
1989	1 590 932	1 629 005	173 031	308 737	3 701 705

Note: FAO is credited as the source for all fishery statistics presented in this appendix.

TABLE 31

Southeast Atlantic catch by state

Year	Coastal states	Former USSR	Spain	Other distant-water states	Total
	(Tonnes)				
1970	1 664 701	422 200	246 000	186 073	2 518 974
1971	1 564 622	438 600	223 600	239 186	2 466 008
1972	1 833 210	719 800	201 500	266 094	3 020 604
1973	1 982 209	648 600	211 900	336 213	3 178 922
1974	1 922 236	447 480	157 987	309 226	2 836 929
1975	1 618 716	420 734	199 891	346 844	2 586 185
1976	1 334 897	841 250	202 964	393 616	2 772 727
1977	1 162 861	1 047 226	175 935	409 553	2 795 575
1978	1 165 964	1 496 362	161 265	474 029	3 297 620
1979	1 126 491	850 664	146 861	439 163	2 563 179
1980	957 954	825 208	128 132	283 222	2 194 516
1981	1 010 296	904 000	193 995	311 978	2 420 269
1982	947 934	887 840	188 623	360 602	2 384 999
1983	1 058 662	631 459	176 505	482 328	2 348 954
1984	833 862	702 998	163 094	466 503	2 166 457
1985	876 348	697 944	188 054	363 888	2 126 234
1986	904 860	679 222	199 451	363 767	2 147 300
1987	1 554 488	670 462	195 596	328 063	2 748 609
1988	1 444 633	634 559	192 559	249 475	2 521 226
1989	1 020 006	654 283	195 638	246 984	2 116 911

TABLE 32

Northeast Pacific catch by six major states

Year	United States	Japan	Former USSR	Canada	Korea, Rep.	Poland
	(Tonnes)					
1970	396 600	1 390 800	739 500	116 700	0	0
1971	350 900	1 188 000	656 000	112 800	0	0
1972	358 500	1 358 300	869 200	161 800	0	0
1973	366 900	964 100	379 800	183 200	0	2 400
1974	360 832	1 087 273	697 700	141 124	0	44 651
1975	352 613	1 113 803	572 597	132 965	3 267	58 738
1976	443 278	1 105 067	496 704	180 880	109 171	30 714
1977	481 875	808 695	185 120	204 317	64 143	24 509
1978	516 375	765 928	248 834	200 581	116 565	29 372
1979	593 507	846 221	210 259	159 803	119 713	63 972
1980	653 674	813 374	59 208	143 451	182 246	115 954
1981	806 594	936 527	2 589	183 127	265 870	159 942
1982	845 010	859 539	3 300	157 835	260 679	9 971
1983	1 017 703	801 630	2 400	191 540	362 757	13 805
1984	1 270 603	722 030	22 816	169 160	399 541	81 185
1985	1 614 024	551 548	10 971	214 732	399 147	91 675
1986	2 035 720	329 120	8 998	219 420	518 438	93 245
1987	2 571 670	218 331	11 202	247 228	320 129	58 842
1988	2 811 564	53 945	12 109	260 890	135 245	44 798
1989	2 786 566	46 578	12 869	265 431	140 143	19 284

TABLE 33

Squid: areas of increasing catch

Year	Southwest Atlantic	Southwest Pacific	Eastern central Pacific	Western Indian Ocean	Eastern Indian Ocean	Northeast Pacific	Total in selected areas
	(Tonnes)						
1970	1 300	0	11 300	6 600	700	0	19 900
1971	1 800	0	14 400	8 500	400	0	25 100
1972	1 800	100	9 300	11 100	300	200	22 800
1973	4 100	15 500	5 600	11 100	400	400	37 100
1974	5 000	24 626	13 203	13 089	1 010	251	57 179
1975	4 652	19 791	11 099	13 895	2 614	627	52 678
1976	8 266	19 692	10 126	16 658	2 076	453	57 271
1977	2 632	55 460	9 462	21 719	10 488	3 444	103 205
1978	72 469	36 786	18 600	18 586	10 536	3 356	160 333
1979	121 661	51 180	21 115	24 109	22 962	2 115	243 142
1980	29 787	114 330	30 532	19 040	16 588	2 310	212 587
1981	52 814	94 074	31 995	11 523	18 453	6 712	215 571
1982	207 194	110 978	19 432	12 336	18 692	23 171	391 803
1983	203 876	106 485	15 875	11 399	20 463	34 162	392 260
1984	249 976	149 711	17 518	20 129	27 726	31 531	496 591
1985	267 705	121 907	24 317	24 104	22 958	45 152	506 143
1986	348 931	99 932	34 872	24 839	28 216	41 445	578 235
1987	738 586	110 996	67 569	31 410	40 678	55 279	1 044 518
1988	678 885	101 275	75 673	40 880	47 716	47 848	992 277
1989	734 356	156 622	63 219	59 345	51 524	41 700	1 106 766

TABLE 34

Squid: eastern central Atlantic catch by state

Year	Japan	Korea, Rep.	Mauritania	Morocco	Spain	Former USSR	Total eastern central Atlantic
	(Tonnes)						
1970	5 000	0	400	1 700	7 400	1 400	15 900
1971	5 100	2 800	400	1 100	7 400	2 800	19 600
1972	4 300	2 000	100	1 100	12 900	5 100	25 500
1973	4 100	4 700	100	2 400	17 900	4 100	33 300
1974	5 965	20 468	100	3 864	26 581	7 100	64 078
1975	1 152	18 277	1 460	1 040	18 257	598	40 784
1976	389	19 707	1 865	1 076	8 615	525	32 177
1977	472	9 148	2 373	1 040	1 429	1 607	16 069
1978	343	7 388	2 430	909	14 830	736	26 636
1979	170	19 706	543	715	11 197	264	32 595
1980	6	13 919	500	2 101	7 606	611	24 743
1981	1 050	17 922	865	4 307	6 422	508	31 074
1982	0	2 919	417	2 369	6 950	2 578	15 233
1983	0	3 099	300	2 746	6 630	377	13 152
1984	0	1 213	184	3 316	732	608	6 053
1985	0	1 453	351	1 785	804	2 362	6 755
1986	0	1 457	499	2 139	439	5 889	10 423
1987	0	1 816	200	4 735	247	1 440	8 438
1988	0	3 139	98	5 092	233	3 266	11 828
1989	0	3 182	702	5 348	199	622	10 053
TOTAL	28 047	154 313	13 887	48 882	156 771	42 491	444 391

TABLE 35

Western Indian Ocean tuna catch by France and Spain

Year	France		Spain	
	Skipjack tuna	Yellowfin tuna	Skipjack tuna	Yellowfin tuna
	(Tonnes)			
1980	0	0	0	0
1981	210	260	179	363
1982	771	1 224	14	55
1983	10 075	10 773	0	0
1984	25 517	33 611	8 079	13 796
1985	33 084	32 231	22 854	15 411
1986	40 363	35 519	24 877	17 532
1987	48 765	37 118	35 399	20 361
1988	45 169	54 149	52 863	43 159
1989	43 082	38 411	77 632	33 852

TABLE 36

Southwest Atlantic catch by coastal distant-water states

Year	Brazil	Argentina	Uruguay	Poland	Japan	Former USSR	Taiwan, Province of China	Korea, Rep.	Spain
	(Tonnes)								
1970	480 140	208 600	13 200	0	13 800	9 700	9 743	0	0
1971	525 458	222 306	14 400	0	1 900	9 100	7 738	0	0
1972	542 518	231 100	20 600	0	4 800	2 100	7 192	0	0
1973	675 843	293 987	17 500	0	500	5 700	7 961	0	0
1974	546 908	285 784	15 700	0	87	8 400	11 071	0	0
1975	579 099	217 141	26 088	0	386	8 684	6 247	2 711	0
1976	515 446	272 347	33 625	579	1	9 710	6 118	2 689	0
1977	563 210	393 275	48 053	2 659	184	27 940	4 647	10 559	0
1978	583 763	527 194	73 827	21 035	20 773	0	6 949	6 827	0
1979	656 241	566 893	107 592	73 932	20 368	2 166	5 562	5 170	0
1980	618 562	391 604	120 087	93 186	12 481	27 710	6 719	1 877	0
1981	611 454	365 088	146 653	73 263	22 299	17 200	6 727	4 031	0
1982	619 463	472 720	118 805	247 601	40 340	19 040	6 398	1 968	0
1983	670 556	413 470	143 361	347 857	30 260	66 050	3 237	1 806	16 000
1984	742 828	313 006	132 549	218 710	69 680	58 033	3 163	4 728	13 000
1985	755 719	409 711	137 584	190 127	79 015	70 873	6 368	15 612	9 200
1986	717 289	417 658	139 993	167 688	130 032	77 121	51 826	58 144	58 518
1987	701 628	554 069	136 683	165 180	297 070	168 490	137 323	100 303	61 109
1988	624 313	484 973	107 145	130 883	288 654	259 773	149 267	104 325	84 460
1989	639 997	477 800	121 356	106 732	203 651	282 337	148 581	105 885	82 652

TABLE 37

Northwest Atlantic catch by coastal distant-water states

Year	Coastal states	Former USSR	Spain	Poland	Other distant-water states
	(Tonnes)				
1970	2 240 242	812 400	280 400	216 400	650 982
1971	2 127 382	1 021 600	270 600	269 400	671 480
1972	2 034 177	1 150 000	236 600	267 100	626 423
1973	2 015 218	1 357 300	180 700	255 100	659 993
1974	1 894 253	1 157 033	183 716	215 142	568 236
1975	1 831 986	1 166 927	121 751	187 647	497 921
1976	1 940 381	852 681	72 062	125 488	422 739
1977	2 155 429	432 744	49 518	49 520	325 554
1978	2 346 044	207 681	35 791	18 126	204 299
1979	2 532 199	125 193	40 792	20 621	253 105
1980	2 587 764	108 288	39 728	4 619	155 266
1981	2 566 402	113 951	49 445	9 575	118 851
1982	2 532 957	109 185	36 761	6 919	145 984
1983	2 484 147	85 101	31 825	13 627	119 572
1984	2 441 070	128 827	37 192	9 128	142 042
1985	2 528 904	133 378	66 199	7 892	160 216
1986	2 512 363	147 681	83 756	7 125	238 387
1987	2 660 704	152 324	83 194	7 623	220 355
1988	2 683 150	149 637	63 686	11 880	157 807
1989	2 713 613	155 429	63 538	9 329	182 229

TABLE 38

Southwest Atlantic catch of cephalopods and other fish by distant-water states

Year	Cephalopods	Other fish
	(Tonnes)	
1970	0	31 478
1971	0	17 904
1972	0	17 120
1973	0	13 348
1974	0	18 852
1975	0	17 240
1976	0	17 988
1977	102	40 935
1978	11 286	45 285
1979	30 124	79 073
1980	19 961	119 383
1981	39 107	82 850
1982	164 247	149 013
1983	171 580	292 894
1984	218 264	162 609
1985	245 831	159 956
1986	335 436	236 255
1987	686 140	275 531
1988	662 311	430 153
1989	706 379	288 690

TABLE 39

Change in total marine catch by 20 major states

Country	1970	1989
	(Tonnes)	
Canada	1 294 798	1 504 633
Chile	1 192 900	6 423 309
China	2 141 900	6 327 847
Denmark	1 215 100	1 900 502
Former USSR	6 364 429	10 279 024
Iceland	733 300	1 504 244
India	1 085 600	2 246 403
Indonesia	796 800	1 981 090
Japan	8 619 500	10 861 050
Korea, D.P. Rep.	447 000	1 600 000
Korea, Rep.	737 585	2 750 037
Mexico	337 085	1 236 225
Norway	2 906 270	1 899 465
Peru	12 481 200	6 815 290
Philippines	844 000	1 541 436
South Africa, Rep.	1 217 800	876 281
Spain	1 516 617	1 339 300
Taiwan, Province of China	586 400	1 215 849
Thailand	1 326 101	2 546 200
United States	2 728 300	5 447 920
TOTAL	48 572 685	70 296 105

TABLE 40

Catch by China, Peru and Chile

Year	China	Peru	Chile
	(Tonnes)		
1970	2 132 900	12 446 500	1 173 400
1971	2 394 100	10 478 900	1 454 300
1972	2 724 600	4 649 700	749 100
1973	2 715 000	2 238 200	633 100
1974	3 083 824	4 066 029	1 103 165
1975	3 165 200	3 366 731	871 701
1976	3 258 659	4 300 108	1 329 397
1977	3 375 532	2 447 403	1 278 823
1978	3 319 725	3 380 652	1 884 467
1979	2 910 734	3 554 001	2 591 949
1980	2 971 523	2 647 719	2 769 814
1981	2 971 831	2 645 851	3 401 909
1982	3 334 564	3 435 744	3 753 408
1983	3 322 945	1 485 847	4 063 597
1984	3 587 591	3 213 008	4 549 493
1985	3 798 126	3 993 512	4 846 888
1986	4 413 002	5 484 662	5 545 031
1987	5 116 529	4 473 917	4 771 970
1988	5 662 688	6 518 986	5 194 907
1989	6 185 891	6 727 957	6 449 032

TABLE 41

Republic of Korea: catch in distant waters

Year	Eastern central Atlantic	Western Indian Ocean	Southwest Pacific	Eastern central Pacific	Western central Pacific	Southwest Atlantic	Northeast Pacific
	(Tonnes)						
1970	23 050	0	0	0	0	0	0
1971	34 494	15 900	30 200	0	0	0	0
1972	36 445	20 500	40 400	0	0	0	0
1973	58 749	25 600	43 200	0	0	0	0
1974	67 706	37 486	43 986	0	0	0	0
1975	92 952	34 432	38 425	8 318	1 093	2 071	3 267
1976	102 252	29 612	24 889	28 807	15 561	2 305	109 047
1977	96 979	58 438	49 957	23 637	14 670	8 830	64 131
1978	93 004	60 096	43 124	12 150	15 454	6 165	116 279
1979	91 428	34 936	42 015	14 098	18 118	4 464	119 076
1980	78 179	31 979	27 515	11 055	15 120	1 801	180 920
1981	95 399	38 690	30 313	13 912	9 210	3 916	263 976
1982	84 444	48 120	33 785	18 542	14 142	1 721	259 259
1983	60 321	43 184	15 738	21 872	17 406	1 686	362 412
1984	44 282	30 884	17 435	21 636	16 411	3 339	394 449
1985	47 416	39 078	9 032	47 021	14 633	14 538	398 000
1986	43 702	50 476	8 557	55 433	29 719	53 646	517 880
1987	44 893	48 415	16 960	50 617	61 474	93 071	319 755
1988	29 031	50 224	19 592	45 196	82 291	100 035	133 562
1989	29 912	41 178	20 076	46 590	85 293	101 439	138 436

TABLE42

Taiwan Province of China: catch in distant waters

Year	Western central Pacific	Western Indian Ocean	Southeast Atlantic	Eastern Indian Ocean	Eastern central Pacific	Southwest Atlantic
	(Tonnes)					
1970	7 200	22 100	7 599	9 100	2 500	7 662
1971	6 031	9 106	14 616	2 531	2 100	6 425
1972	3 822	5 566	21 549	2 400	4 100	6 004
1973	3 222	3 564	17 815	2 065	6 300	6 327
1974	1 095	3 900	10 888	3 081	4 710	9 514
1975	825	1 865	13 042	1 575	8 374	5 100
1976	927	2 459	13 841	1 369	7 227	4 890
1977	6 510	10 968	15 697	7 002	11 762	3 958
1978	8 974	11 485	18 544	9 057	10 251	5 998
1979	7 748	15 468	19 475	8 341	9 817	3 541
1980	8 900	10 474	14 918	10 234	9 984	6 117
1981	5 150	18 492	12 804	9 513	7 796	5 875
1982	14 739	22 703	13 666	12 177	2 300	5 829
1983	19 823	20 493	6 812	17 403	3 831	2 837
1984	22 367	15 503	5 518	11 939	7 148	2 934
1985	32 735	13 790	12 982	11 648	8 957	5 992
1986	34 687	23 301	16 227	25 431	8 508	51 552
1987	43 977	25 733	9 228	17 936	9 660	136 523
1988	59 553	36 409	11 032	22 082	10 630	147 237
1989	69 565	31 266	9 074	22 213	12 500	146 357

TABLE43

Japan: catch in distant waters

Year	Western central Pacific	Southwest Pacific	Eastern central Pacific	Southeast Atlantic	Southwest Atlantic	Eastern central Atlantic	Antarctic Atlantic	Northeast Pacific
	(Tonnes)							
1970	98 800	31 100	93 500	69 000	0	111 300	0	1 369 400
1971	122 200	48 100	75 500	103 000	0	89 700	0	1 178 900
1972	131 700	56 400	86 300	96 200	0	79 800	0	1 378 100
1973	159 500	59 700	83 700	114 500	0	86 200	59	941 400
1974	276 406	75 311	71 378	112 257	0	100 194	200	1 083 325
1975	198 338	66 696	66 759	116 812	218	66 020	0	1 110 216
1976	219 933	104 625	113 681	103 636	0	56 082	0	1 092 105
1977	238 203	161 451	120 140	91 142	155	57 266	0	801 431
1978	309 452	75 315	94 958	60 796	19 112	52 491	0	757 927
1979	231 831	74 661	114 133	57 808	19 587	38 014	0	835 409
1980	272 684	126 768	112 097	50 770	10 841	25 996	0	802 552
1981	248 880	128 195	123 021	51 902	20 037	36 840	3 751	924 469
1982	249 018	118 260	124 055	48 621	37 662	30 805	5 404	843 853
1983	289 478	121 258	112 623	40 402	28 342	14 561	5 498	790 530
1984	296 024	153 956	116 304	46 288	67 314	15 492	40 710	710 410
1985	171 021	141 683	217 482	38 283	69 205	15 879	31 304	541 270
1986	335 261	180 896	161 685	36 191	118 140	9 353	53 804	321 993
1987	310 911	231 707	179 951	33 068	271 784	11 275	74 309	214 366
1988	335 664	280 590	146 657	38 842	252 065	20 538	73 230	48 086
1989	308 433	272 351	141 984	31 234	184 733	18 999	79 024	41 700

TABLE 44

Japan: total marine catch and catch less pilchard

Year	Total marine catch	Catch less pilchard
	(Tonnes)	
1970	8 400 300	8 383 500
1971	8 966 300	8 908 900
1972	9 337 300	9 279 400
1973	9 683 659	9 386 759
1974	9 718 276	9 366 592
1975	9 522 682	8 996 635
1976	9 610 585	8 544 893
1977	9 692 435	8 271 923
1978	9 773 766	8 136 386
1979	9 582 422	7 842 256
1980	10 085 726	7 887 982
1981	10 331 268	7 241 957
1982	10 428 691	7 138 737
1983	10 846 336	7 101 188
1984	11 612 098	7 432 672
1985	10 970 576	7 103 648
1986	11 532 605	7 323 092
1987	11 362 470	7 000 445
1988	11 541 468	7 053 057
1989	10 045 000	6 367 000

TABLE 45

Former USSR: marine catch in nine major areas

Year	Northwest Pacific	Northeast Atlantic	Eastern central Atlantic	Southeast Atlantic	Northwest Atlantic	Southeast Pacific	Mediterranean and Black Sea	Northeast Pacific	Antarctic Atlantic
	(Tonnes)								
1970	1 393 000	1 566 300	609 500	419 100	807 000	0	297 900	727 200	410 900
1971	1 509 300	1 380 100	782 602	436 500	991 200	0	241 200	643 800	17 100
1972	1 397 200	1 267 700	839 107	718 300	1 128 900	33 600	258 600	862 100	2 500
1973	2 202 000	1 608 000	931 467	647 000	1 327 900	39 200	265 300	379 800	400
1974	2 316 300	1 985 125	1 130 553	445 851	1 138 111	0	348 800	697 600	26 200
1975	2 681 489	2 409 315	1 152 802	419 257	1 134 506	0	323 337	572 407	45 405
1976	2 732 886	2 545 847	1 302 115	840 418	819 955	0	343 413	496 618	29 341
1977	2 914 575	2 000 895	1 123 516	1 045 879	403 139	0	231 852	185 120	183 410
1978	3 011 839	1 735 138	747 766	1 484 548	197 939	54 019	360 430	247 456	205 846
1979	3 244 919	1 945 034	515 769	832 244	115 409	541 483	402 103	209 856	342 819
1980	3 177 328	2 008 438	935 176	816 550	100 962	551 495	473 073	59 181	424 049
1981	3 541 749	1 826 228	774 372	896 696	108 411	603 506	411 074	1 472	361 227
1982	3 965 730	1 448 496	947 187	874 914	109 012	606 747	503 358	3 300	452 214
1983	4 187 453	1 547 056	920 486	623 111	84 935	614 372	433 476	2 350	296 026
1984	5 419 426	1 386 018	656 312	691 982	128 375	604 642	467 873	22 811	172 640
1985	5 411 990	1 258 436	696 644	688 096	133 091	624 397	410 514	10 971	187 749
1986	5 777 985	1 019 254	840 856	669 636	147 617	710 891	480 640	8 998	396 826
1987	5 450 856	962 062	1 049 914	648 860	149 962	844 936	332 580	11 202	347 654
1988	5 301 018	801 928	1 379 070	622 570	149 217	944 690	434 873	12 109	353 583
1989	4 914 971	660 875	1 621 042	647 684	153 893	1 202 244	285 178	12 541	369 251

TABLE 46

Former USSR: Alaska pollack catch and other marine catch

Year	Alaska pollack	Other marine catch
	(Tonnes)	
1970	697 000	5 577 600
1971	861 900	5 405 102
1972	1 029 400	5 735 507
1973	1 339 200	6 303 767
1974	1 754 200	6 590 840
1975	1 958 116	6 996 526
1976	2 090 869	7 159 108
1977	1 975 140	6 288 429
1978	2 011 918	6 292 536
1979	2 048 833	6 197 314
1980	2 111 669	6 638 624
1981	2 137 875	6 630 032
1982	2 497 907	6 638 588
1983	2 747 044	6 184 037
1984	3 449 559	6 243 402
1985	3 343 034	6 216 497
1986	3 584 140	6 727 498
1987	3 421 719	6 723 312
1988	3 369 858	6 960 112
1989	3 133 152	7 039 120

TABLE 47

Norway: total marine catch by selected species groups

Year	Total cod and haddock	Atlantic mackerel	Total herring	Sand eel (sandlance)	Atlantic salmon	Other	Capelin
	(Tonnes)						
1970	825 000	278 800	368 100	600	1 000	107 307	1 301 000
1971	881 900	202 600	315 000	2 100	1 300	212 285	1 371 200
1972	922 600	159 800	309 900	18 800	1 800	145 736	1 556 400
1973	821 600	337 600	216 100	17 200	1 900	171 099	1 332 100
1974	906 803	287 806	117 037	77 968	2 001	145 764	1 030 158
1975	904 959	243 440	206 682	54 139	2 142	79 915	980 202
1976	898 633	212 119	150 587	44 408	2 530	73 161	1 972 289
1977	873 198	181 742	54 635	78 761	3 321	65 041	2 137 200
1978	911 581	92 897	122 252	93 971	4 357	73 451	1 280 630
1979	998 815	125 497	99 479	102 433	5 917	78 558	1 232 177
1980	862 994	76 920	94 675	148 444	5 875	88 471	1 118 069
1981	942 396	62 099	32 108	54 319	9 797	90 904	1 347 258
1982	1 023 693	74 069	71 434	47 738	11 782	107 680	1 152 945
1983	983 824	79 970	91 444	12 442	18 572	144 115	1 492 672
1984	998 571	142 538	173 456	30 291	23 236	140 210	945 567
1985	891 484	115 358	256 598	15 653	30 796	157 043	640 810
1986	870 810	156 749	335 297	87 675	46 160	130 758	272 632
1987	863 973	157 174	356 521	198 869	48 466	162 193	142 414
1988	783 618	162 139	350 722	191 653	81 380	180 081	72 671
1989	818 853	143 415	274 004	194 425	116 164	228 351	108 270

TABLE 48

United States: northeast Pacific whitefish catch[1]

Year	Pacific cod	North Pacific hake	Sablefish	Flatfish[2]	Pacific halibut	Yellowfin sole	Other
	(Tonnes)						
1970	1 300	4 100	1 600	15 100	15 600	0	17 500
1971	2 800	4 800	1 200	13 900	12 800	0	14 500
1972	4 800	1 900	4 200	19 700	11 600	0	17 200
1973	3 800	1 200	4 500	20 700	10 400	0	19 400
1974	4 542	2 382	4 125	21 210	8 407	0	15 906
1975	5 551	1 524	5 080	21 114	9 626	0	14 962
1976	5 870	1 911	4 302	22 860	8 231	0	19 483
1977	4 966	1 616	5 995	22 855	7 967	0	24 166
1978	4 952	3 138	7 754	19 999	7 926	0	22 507
1979	6 323	13 925	14 706	24 096	9 573	0	32 112
1980	8 923	5 438	7 609	20 422	8 603	0	43 826
1981	29 063	48 649	8 796	26 277	12 111	15 975	56 528
1982	45 938	74 589	16 888	35 358	14 296	17 414	62 337
1983	66 186	79 969	14 850	37 964	19 935	22 529	54 825
1984	90 950	85 582	21 247	42 659	21 652	33 025	73 262
1985	90 929	38 910	25 345	63 747	27 594	134 518	74 984
1986	113 390	93 253	35 789	81 695	35 195	152 312	78 779
1987	136 900	229 576	43 753	75 170	34 464	181 403	98 421
1988	232 729	142 907	46 369	148 181	36 939	218 793	80 178
1989	213 224	211 082	41 923	52 451	34 076	152 777	130 080

[1] Excluding Alaska pollack.
[2] Not elsewhere included.

TABLE 49

United States: total catch by group[1]

Year	Total Fish-meal fish	Total tuna	Total salmon	Total shrimp	Other	East coast whitefish	West coast whitefish	Alaska pollack (walleye pollack)
	(Tonnes)							
1970	993 900	214 000	186 000	163 900	198 800	260 300	55 200	200
1971	1 109 900	213 800	150 900	176 100	212 500	240 500	50 000	100
1972	1 034 400	241 300	105 200	174 500	229 900	228 400	59 400	100
1973	1 053 300	236 100	100 600	169 600	209 700	255 000	60 000	0
1974	1 074 370	252 591	91 388	165 277	232 356	248 788	56 572	57
1975	1 054 465	259 153	91 627	152 454	228 337	249 586	57 857	21
1976	1 140 975	301 039	140 649	183 304	245 794	254 201	62 657	229
1977	1 008 427	212 010	152 247	211 628	310 065	266 979	67 565	323
1978	1 283 794	251 428	183 475	186 842	330 377	291 175	66 276	1 765
1979	1 345 540	218 273	243 180	148 430	345 501	305 567	100 735	3 132
1980	1 337 029	225 886	278 422	157 651	382 182	321 513	94 821	1 409
1981	1 145 160	221 105	294 129	156 129	354 026	286 121	197 399	60 691
1982	1 411 553	198 193	275 522	132 191	333 175	268 636	266 820	130 365
1983	1 447 093	264 446	289 980	117 305	299 766	276 501	296 258	284 486
1984	1 416 299	264 165	313 622	133 065	302 943	261 572	368 377	455 149
1985	1 356 857	233 775	329 722	148 577	321 973	208 122	456 027	656 446
1986	1 199 949	251 126	298 696	175 889	350 058	201 906	590 413	963 271
1987	1 346 653	282 521	255 031	159 106	382 036	195 638	799 687	1 307 722
1988	1 123 811	272 843	256 443	146 103	414 020	186 214	906 096	1 396 849
1989	1 072 819	242 169	352 806	156 918	418 643	160 360	835 613	1 359 146

[1] Excluding clams.

TABLE 50

Eastern Europe: catch of nine major species

Year	Atlantic herring	Cape horse mackerel	Atlantic cod	Atlantic mackerel	Jack and horse mackerel[1]	Alaska pollack (walleye pollack)	European sprat	Southern blue whiting	European pilchard
	(Tonnes)								
1970	208 400	2 300	173 300	86 100	24 400	0	30 900	0	2 100
1971	205 600	6 200	123 800	225 700	28 500	0	51 700	0	4 800
1972	211 500	3 000	144 900	263 200	34 500	0	58 200	0	4 100
1973	245 000	10 500	124 700	249 000	46 300	0	68 400	0	19 900
1974	223 177	12 619	136 839	227 327	46 450	0	81 940	0	52 712
1975	225 243	48 748	144 481	198 191	51 716	631	94 956	0	137 386
1976	154 974	59 593	130 765	176 681	34 524	21	86 375	0	147 363
1977	122 791	100 118	77 194	32 366	75 991	1 376	79 366	2 057	206 345
1978	110 111	175 626	83 940	285	78 269	1 229	54 370	11 717	35 519
1979	129 409	167 442	105 135	180	103 152	40 356	33 697	35 870	3 387
1980	127 802	119 928	133 118	31	186 098	60 974	33 741	54 218	39 772
1981	120 648	196 369	135 656	4 480	154 070	92 889	32 446	48 419	10 000
1982	127 197	217 822	104 703	4 956	136 047	443	34 802	130 173	0
1983	134 319	275 719	88 523	5 603	108 145	0	26 613	233 029	5 518
1984	128 398	234 413	104 214	10 937	86 077	53 706	32 092	102 732	2 071
1985	137 480	148 394	70 961	18 783	71 620	146 670	46 865	76 685	8 399
1986	130 170	160 625	47 979	25 847	104 926	170 124	50 150	98 681	13 309
1987	110 682	145 402	38 812	24 953	111 900	230 340	56 647	48 976	24 581
1988	114 264	90 534	38 644	31 666	66 214	298 715	39 246	48 535	32 587
1989	113 450	94 449	34 386	28 725	47 735	268 565	38 077	42 186	31 954

[1] Not elsewhere included.

TABLE 51

Eastern Europe: catch in areas excluding North America

Year	Northeast Atlantic	Eastern central Atlantic	Southwest Atlantic	Southeast Atlantic	Northwest Pacific	Southeast Pacific
	(Tonnes)					
1970	383 200	90 600	0	40 100	0	0
1971	321 100	87 700	0	32 000	0	0
1972	342 400	82 300	0	33 300	0	0
1973	361 300	86 300	0	68 400	0	0
1974	489 871	125 347	0	75 113	0	0
1975	546 432	213 310	0	106 829	0	0
1976	476 372	194 384	0	166 501	0	0
1977	319 071	342 688	2 060	187 293	0	0
1978	312 440	136 182	16 642	257 571	0	0
1979	316 487	150 918	64 758	239 881	0	5 906
1980	330 388	284 120	81 410	143 635	0	15 593
1981	313 849	191 247	70 672	210 280	0	12 629
1982	283 139	162 071	245 508	257 173	0	20 697
1983	254 679	90 334	347 915	361 826	0	64 267
1984	270 572	61 509	234 922	326 671	0	94 823
1985	262 730	97 817	214 975	218 464	115 874	2 290
1986	247 342	93 207	189 989	228 523	163 249	0
1987	220 397	143 746	189 125	180 836	230 318	0
1988	220 469	125 180	171 173	117 309	298 714	0
1989	198 607	86 038	146 609	124 319	268 560	0

TABLE 52

Eastern Europe: catch off North America

Year	Northeast Pacific	Northwest Atlantic
	(.....Tonnes.....)	
1970	0	313 100
1971	0	448 600
1972	0	467 300
1973	6 700	464 100
1974	45 600	367 614
1975	45 660	314 559
1976	75 278	210 323
1977	23 562	72 021
1978	28 900	25 195
1979	63 322	36 536
1980	111 790	9 985
1981	163 824	13 992
1982	17 196	11 596
1983	13 346	20 698
1984	80 514	21 655
1985	91 180	25 169
1986	92 520	33 071
1987	58 011	34 884
1988	44 192	39 024
1989	18 220	31 902

TABLE 53

Spain: marine catch by area

Year	Northeast Atlantic	Mediterranean and Black Sea	Eastern central Atlantic	Southeast Atlantic	Northwest Atlantic	Western Indian Ocean	Southwest Atlantic	Western central Atlantic
	(.....Tonnes.....)							
1970	634 355	118 169	219 245	246 000	280 400	0	0	0
1971	622 137	118 316	218 381	223 600	270 600	0	0	0
1972	714 137	90 388	239 780	201 500	236 600	4 100	0	489
1973	652 189	120 927	370 240	211 900	180 700	5 100	0	0
1974	600 920	117 387	410 393	157 046	179 528	2 710	0	0
1975	634 366	138 352	377 243	199 458	117 385	2 878	0	762
1976	658 430	147 061	405 582	202 251	71 899	1 320	0	0
1977	598 199	139 724	432 199	172 442	49 232	1 466	0	266
1978	558 504	143 463	478 454	158 482	35 100	1 466	0	2 029
1979	539 477	148 393	363 071	145 250	39 354	0	0	1 052
1980	511 644	146 338	441 416	126 981	38 825	0	0	0
1981	517 295	149 910	399 736	188 985	47 874	542	0	0
1982	632 164	159 794	407 709	187 125	35 103	69	0	0
1983	605 366	159 185	379 326	173 707	30 841	0	16 000	1 957
1984	638 461	150 835	366 293	159 198	35 981	22 684	13 000	3 976
1985	623 199	136 592	377 770	186 903	60 815	38 426	9 200	1 000
1986	603 659	140 600	265 721	198 069	82 083	42 959	58 518	0
1987	622 958	128 278	199 688	194 013	78 764	57 685	56 075	0
1988	620 600	132 085	191 048	191 236	59 843	98 868	76 097	0
1989	561 842	131 083	171 529	192 700	61 857	115 021	77 193	0

TABLE 54

Spain: catch of major tuna by area

Year	Northeast and western central Atlantic	Eastern central Atlantic	Western Indian Ocean
	(.....Tonnes.....)		
1970	26 616	20 045	0
1971	31 971	31 016	0
1972	26 497	38 580	0
1973	21 999	42 340	0
1974	26 392	59 771	0
1975	23 010	52 027	0
1976	27 249	57 172	0
1977	26 110	68 387	0
1978	28 750	68 259	0
1979	32 861	65 612	0
1980	26 622	74 488	0
1981	21 533	98 055	542
1982	27 740	101 687	69
1983	34 886	90 330	0
1984	23 486	101 153	22 684
1985	23 699	113 799	38 426
1986	26 742	117 285	42 959
1987	30 476	113 417	57 685
1988	31 742	110 144	98 868
1989	28 583	105 006	115 021

TABLE 55

Total catch by states in non-local areas

Year	Total catch (all states)
	(.....Tonnes.....)
1970	7 544 137
1971	7 478 677
1972	8 549 749
1973	8 144 732
1974	8 360 756
1975	8 080 103
1976	8 268 868
1977	7 945 652
1978	7 333 889
1979	6 662 499
1980	7 392 884
1981	7 215 932
1982	7 375 155
1983	7 276 798
1984	6 989 962
1985	6 959 703
1986	8 004 878
1987	8 525 497
1988	8 701 362
1989	8 958 413

TABLE 56

Catch by major distant-water states in non-local areas, 1970

Country	Catch
	(.....Tonnes.....)
Former USSR	3 053 029
Japan	2 049 300
Spain	750 945
Poland	247 600
Portugal	214 702
Germany, Fed. Rep.	206 300
Others	1 022 261
TOTAL	7 544 137

TABLE 57

Catch by major distant-water states in non-local areas, 1989

Country	Catch
	(.....Tonnes.....)
Former USSR	4 547 530
Japan	1 492 727
Spain	634 722
Korea, Rep.	580 234
Poland	410 991
Taiwan, Province of China	327 719
Others	964 490
TOTAL	8 958 413

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